Bladder Control in Infancy and Early Childhood

Hjalmar Fletcher Scoe

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Professor George D. Stoddard, Ph.D., Editor

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BLADDER CONTROL IN INFANCY AND EARLY CHILDHOOD

by

Hjalmar Fletcher Scoe, Ph.D.

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FOREWORD

Doctor Scoe's systematic inquiry into the conditioning factors in bladder control in young children should make unnecessary further additions to the fragmentary studies which have previously characterized this field. For comparatively large groups of infants reliable information is given on interference factors, the place of child responsibility, the expected age of control, sex differences in control (and the reason for them), and the features of a practical program of conditioning.

Both psychologically and practically bladder control, in its initial stages, is not to be viewed as an all-or-none affair, but as a slowly maturating function.

George D. Stoddard

Office of the Director
Iowa Child Welfare Research Station
University of Iowa
January 11, 1933

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CHAPTER I

THE SCOPE OF THE INVESTIGATION

Infant organisms, either human or infrahuman, and their early adjustment to environmental conditions may be investigated from the point of view of two sciences, namely, that of psychology and that of neurology. The psychology of infancy is concerned with the transformations of behavior patterns which have their origins in the prenatal and postnatal periods. The problem for neurology is to investigate the structural and histological changes in the nervous system which parallel the behavior changes.

Langworthy (30), Coghill (11), and Tracy (46) have attempted to investigate both aspects of this problem during the early developmental periods of certain infrahuman forms. The technical difficulties of this dual approach increase with organisms higher in the phyletic scale. Langworthy has but recently begun this problem in the case of the human organism.

An attack on this problem can be made by selecting for investigation a given behavior pattern and following it from early infancy to the stage where it becomes established in its approximate adult status.

The development of urinary control is such a problem. The development of bladder control may be studied as a neural or psychological problem. The latter phase has been selected for investigation in this study.

POSSIBILITIES AND LIMITATIONS OF THE INVESTIGATION

In order to obtain complete information relative to bladder control in infancy and early childhood there are two possibilities of investigation: the laboratory and the home. The laboratory employs experimental and controlled groups for purposes of comparison and contrast, thereby contributing exact data on the problem under investigation. The most serious limitation to this method is that it artificially controls certain factors which may be vital to the problem. Especially is this true of investigations in the field of social phenomena. Accordingly, its findings are often of questionable application to ordinary situations outside the laboratory. The home, on the other hand, offers opportunities for systematic observations of the child as a functioning unit in a setting with numerous factors. The findings, while less exact, are more readily applicable to ordinary social conditions. The home, however, is often unfavorable to systematic observations because of numerous interruptions and inconsistencies in its routine. Rigid controls obviously cannot be established. That variable conditions are present in a given home and from home to home is a matter of common observation.

However, despite these limitations research in the field of child development must be staged in the complex settings of the home, as well as in the clinic and laboratory if the factors contributing to the child's development are to be known or estimated. The home should be looked upon as an important medium through which the student of child psychology, as well as the parent, may learn new facts and relationships about the child. Bott (9) justifies the study of the child under home conditions by stating that if research in child development is to become vital for all persons having responsibility with children, the experimental worker must come out of his laboratory into the home or school situation, which is after all the real laboratory for studying the sort of things that, as educators or parents, we are concerned to know.

In selecting the home as a medium for research the problem is to conserve the advantages of the home and at the same time safeguard the results by adhering as closely as possible to the techniques of the laboratory. In the present study it was found possible to set up certain controls in the home situation. Attempts to do this were made in four directions: (1) a uniform set of instructions and symbols for systematic observations was given each mother, (2) unsatisfactory equipment and physical conditions were altered when possible, (3) data from three other groups were gathered for comparative purposes, and (4) by equating for several factors affecting progress, the main experimental group could be divided into what approximates an experimental and a control group, i.e., homes having few interferences to systematic observations may serve as controls for homes having many interferences, or homes making highly regular observations may serve as controls for those making irregular or less regular observations. Thus, many factors of the home may be largely controlled and the data collected under these conditions may be compared or contrasted in a manner approximating the exactitude of the laboratory without sacrificing the advantage of conducting the investigation in the actual situation of the home.

STATEMENT OF PROBLEM

Bladder control is among the earliest of the deliberate habits which the child is expected to acquire. Gaining this control is a study of how an automatic function is modified and placed under voluntary control. Some of the factors which would seem to be involved in this transition are: (1) frequency of voiding, (2) length of interval between voidings, (3) age and sex of subjects, (4) type of training, and (5) interferences in the training program. An investigation of these factors and the stages through which the child gains control of the bladder function under conditions in the home are the general considerations of this study. More specifically, this investigation has the following objectives: (1) to investigate home practices relative to gaining urinary control, (2) to evolve a method of parent coöperation in the study of bladder control under home conditions, (3) to evolve measures for determining the degree of success of bladder control, (4) to find at what age it is advisable to begin training for bladder control, (5) to determine the effects of training at the various age levels, (6) to estimate the various factors which interfere with the establishment and maintenance of control, (7) to make a study of the progress of typical infants, and (8) to evolve a method of training.

RELATED STUDIES

Psychological Factors Affecting Bladder Control

No thoroughgoing investigation of the psychological factors affecting the establishment of bladder control has been made. Hull and Hull (24) report a study of their own child in gaining voluntary control and in the acquisition of spoken vocabulary. They advance the hypothesis that learning to talk interferes with the gaining of voluntary control of the bladder as evidenced by the vocabulary curve in its early stages paralleling the plateau period in the curve of voluntary control of bladder. This is a study of a single child and has not considered many other factors which are pertinent to bladder control.

In the main, attention has been devoted to the child who has failed to establish urinary control. From the numerous studies reported on the various phases of the problem of enuresis such studies have been selected which contribute to a specific aspect of the problem.

ENURESIS

Prevalence

Statistically the incidence of enuresis is unknown. The impressions of pediatricians, psychiatrists, and clinical psychologists are that the difficulty is common and widespread. The following tabulation indicates the prevalence among certain institutional and clinical groups. The statistics on enuresis indicated here show a range of variability from 2 to 35 per cent:

Group	Author	Population	Enuretic	Per Cent
Clinical, both sexes	Ackerson & Highlander (1)	3000	690	23
Nervous, both sexes	Dunkam (13)	800	56	7
Institution, boys	Eldora Training School (14)	460	78	17
Clinical, both sexes	Healy & Bronner (23)	355	46	13
Delinquent, both sexes	Healy & Bronner (23)	264	40	15
Institution, girls	Jacobs (26)	430	8	2
Institution, boys	Jacobs (26)	650	100	15
Clinical, both sexes	Mohr & Waterhouse (32)	90	15	17
Institution, boys	Partridge (37)			10
Problem, both sexes	Tilson (45)	225	79	35

To estimate the prevalence among the general population of children from this table would, of course, be difficult.

Relation to Sex

Closely related to the question of general prevalence of enuresis is that of sex prevalence. The following tabulation likewise has been taken from enuresis studies on clinical and institutional groups and the relationships indicated do not obtain for the general population.

Author	Total Cases	Boys	Per Cent	Girls	Per Cent
Anderson (4)	148	108	73	40	27
Benjamin (6)	11	5	46	6	54
Blatz (7)	18	13	62	5	28
Blau (8)	90	41	46	49	54
Breckenridge (10)	28	14	50	14	50
Grover (20)	200	124	62	76	38
Hamill (21)	80	54	68	26	32
Jacobs (26)	108	100	93	8	7
Mohr & Waterhouse (32)	15	9	60	6	40
Muldawer (34)	110	63	57	47	43
Schwartz (42)	226	148	65	78	35
Tilson (45)	79	47	60	32	40

In general, these studies indicate a definite preponderance among boys; 50 to 70 per cent prevalence for boys as compared to 30 to 50 per cent for girls. For this apparent sex difference no explanation has been presented. In a later chapter an attempt will be made to relate what appears here to be a definite sex difference to certain other findings of this study.

Etiology

That urinary incontinence may be traced in a very large degree to lack of early training or to faulty training is evidenced by such studies as Anderson (4), Blatz (7), Emerson (15), Hamill (21), Muldawer (34), and Schroeder (41).

Anderson in his study of 148 enuretics found that defective habit training was a factor in 87 per cent of all cases. In more than 80 per cent the onset was from birth. Emerson, who successfully treated thirty-four enuresis cases by psycho-therapy methods, states that enuresis is not a disease but simply the persistence of an infantile condition or habit. Muldawer reports eighty-six of his 110 enuretic patients suffered from urinary incontinence from infancy. Schroeder's study of forty-four older boys indicates that 37 per cent were incontinent from infancy. Blatz reports that all but one of eighteen enuretics suffered from a continuation of the infantile adjustment. Hamill, employing psychological treatment in the correction of eighty enuresis cases, states that pursuit of physical causes leads directly away from the understanding of such children. The evidence for and against this view is surveyed in the following sections.

Treatment

The treatment of enuresis has proceeded along four lines: (1) removal of physical cause by surgery; (2) drug therapy; (3) psycho-therapy; and (4) educational procedures.

With certain experimenters where the difficulty was held to have a physical basis, such as bad tonsils and adenoids, need for circumcision, poor muscle tonus, and the like, the treatment has been either operative in an attempt to remove the cause or the administration of certain drugs, such as atropine, pituitrin, and belladonna. Most operative measures have been found to be either useless or of questionable value. Grover (20) stated that in his 200 enuresis cases 36 per cent had adenoids removed with no relief, and 49 per cent had tonsils removed with no success. Blau (8) removed enlarged tonsils and adenoids in sixteen cases among ninety enuretics with no change in the urinary status. In cases where phimosis was present circumcision had no therapeutic effects. In Grover's cases 51 per cent of the boys had been circumcised.

The use of drug therapy has resulted in greater success. Blau (8) reports almost 75 per cent improved or cured from the use of pituitrin. Moss (33) used pituitary extract in thirty cases in doses of three grains daily and reports 50 per cent cured and 25 per cent with marked improvement. Wile and Orgel (50) compared the drug with the educational method on two groups of children, fifty in each group, with enuresis. Each method resulted in about the same per cent of cure. The drug method resulted in 38 per cent cure and 40 per cent improvement while the educational method resulted in 38 per cent cure and 34 per cent improvement. Empirically the drug method has shown results, but the real reason for the cure of enuresis is not known. The results appear rather questionable in the face of an experiment made by Friedell (18) at Minnesota, who worked with thirty-nine enuresis cases. To each of these cases was administered a hypodermic injection of 1 cc. of sterile water per week. Each case was assured that the treatment would result in a cure, and if failures resulted the injections would be repeated. Thirty-four successes were reported without a relapse in six months. This study suggests that the beneficial effects of the drug treatment are due less to the drug itself than to the psychological effect of the hypodermic injection.

Psycho-therapeutic measures such as reassurance, hypnosis, suggestion, and the like have been widely used. Hamill (21) reports

72 per cent cure by use of reassurance. Emerson (15) through the use of three degrees of suggestion secured a 100 per cent cure in thirty-four cases of enuresis. Narath (36) treated 182 patients between the ages of five and twenty-eight years by hypnosis with 76 per cent fully cured and 17 per cent improved. Psycho-therapy has proved highly successful where other methods have failed; however, the factors contributing to the child's cure are not known. Nor have the other psychological effects of such treatment been estimated.

Retraining, routine measures, and other educational procedures constitute the chief modes of treatment advocated by the more recent investigations. Wile and Orgel (50) conclude from their comparison of the drug and educational methods that the latter is the rational and most permanent treatment of enuresis. Grover (20) treated 200 cases along routine measures and reports 19 per cent success after the first visit to the clinic. Schroeder (41), working with forty-four adolescent boys, secured 27 per cent cure and 25 per cent improvement following a self-imposed treatment.

Child Guidance Materials

The numerous suggestions and guides on how infants should be trained for bladder control have come, in the main, from clinicians and investigators who have been interested mainly in the child who has failed to gain control of this function. This flood of so-called home guidance literature has given rise to much confusion and worry to the thoughtful parent, because of its many conflicting statements and principles. In general this body of literature emphasizes regularity in training and freedom from distractions as fundamental to a training program of bladder control. Woolley ((51), page 57) has recently evaluated the material in this field and as a result of this evaluation gives the seven following rules to be observed in training for control of the bladder function: "(1) Teach the infant to sit on a toilet-vessel. (2) Observe each infant's natural rhythm of urination. (3) Try to place the child upon the vessel at the probable period of urination very frequently. (4) Try to keep the infant dry as possible—consistently enough so that his being wet is to the infant uncomfortable. (5) Teach the infant to make some sound, or, as soon as he is old enough, to say some word in connection with urination. (6) Teach the child to make the sound, or say the word, as an indication of his need for urination. (7) From the beginning, express gratification and give the baby signs of approval and praise, when the vessel is used for urination.''

SIGNIFICANCE OF INVESTIGATING NORMAL URINARY CONTROL

In the great majority of cases the causes for enuresis seem to be psychological rather than physiological and organic. If this hypothesis is true the problem of gaining control of the bladder function should be envisaged as a psychological one. It is during the age of dependence that the infant, through routine measures, develops proper control of urination. A study of the factors involved in the control of this function in the first years of life should result in a body of data whereby enuresis may be prevented. To the extent that this study points out the factors that contribute to this control in infants it becomes a study in the prevention of enuresis.

THE RELATION OF CORTEX TO MICTURITION

Micturition in young infants is purely an automatic or nonvoluntary function. Later, through routine measures, this function is placed under voluntary control. On the neurological side control means that cortical influences, both inhibitory and excitatory in nature, have been superimposed upon an automatic process. Voluntary micturition should be thought of as involving two distinct actions: first, the relaxation of the external sphincter and urethra walls following which the urine is expelled; and second, the contraction or closure of the external sphincter and urethra walls. Both of these actions should be thought of as positive in nature. It follows that voluntary control on the psychological side is the ability to relax or close the external sphincter and urethra walls at will.

The problem most pertinent to the present study is to discover the psychological factors that contribute to the transition of a noncortical influence. This problem is but a phase of a larger problem —that of the general maturation of the organism. The solution to this problem will involve both the neurological and reaction types of investigations. Irwin (25) points out that the responses of the infant at birth are noncortical. Langworthy's (31) histological work demonstrates the incompleteness of the nervous system of an infant at birth, particularly the incompleteness of the pyramidal tracts from the cortex to the cord. That the cerebral cortex is involved in the voluntary control of micturition is not questioned by physiologists. But indicating the exact pathways and areas involved in the cortex and pointing out the nature of cortical influences on the bladder function are problems for further experimentation. An interesting and valuable contribution to the knowledge of infancy would be to compare the neurological and behavior changes which take place during the period in which the bladder is placed under cortical control. It is the latter of these two aspects of the problem which is attempted in this study.

The subjects of this research vary in ages from two to twenty-seven months. This is the period in which the nervous system attains relatively complete development. It is during this period that control of behavior patterns common to infants is expected.

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CHAPTER II

SUBJECTS AND METHODS OF COLLECTING AND TREATING DATA

SUBJECTS AND SOURCES OF DATA

In this study four different groups of infants were used in sampling the activity of the bladder function. The data were collected by the use of (1) a questionnaire, (2) three-day home records on an undirected group of infants, (3) continuous home records on a training group of infants, and (4) periodic daily records on infants of a laboratory group.

Questionnaire Group

Early in the progress of this study it was apparent that a preliminary survey of existing home practices was important to setting up a training program for bladder control. No reliable information was available in answering such questions as: (1) How early do parents begin training for bowel and bladder control? (2) What practical difficulties are experienced? (3) What training methods are commonly used? (4) When are these controls brought about? A questionnaire was, therefore, constructed which aimed to gather information on home practices relative to the time for starting training, methods used in training, and factors which interfered with training for bowel and bladder control. This questionnaire was addressed to mothers with children under four years of age. The questionnaire was filled out for 172 children, ninety-two boys and eighty girls, under four years of age, from Iowa City, Iowa and vicinity, Cedar Rapids, Iowa, and Fremont County, Iowa. For the greater part, the mothers coöperating in this preliminary survey were members of an organized child study club or had an active interest in the welfare of their children as evidenced by their visits to the Nutrition Clinic of the Iowa Child Welfare Research Station. Approximately one-third of the total mothers coöperating in this survey were reached through the Station clinics. The group represents a fairly select one, and the practices recorded accordingly should be thought of as somewhat superior.

UNDIRECTED GROUP

In gathering data from this group a form was constructed designed to secure a three day record of the child's bladder activity. The days on which observations were recorded were not necessarily consecutive, but occurred within a given week. On this form the mother recorded the approximate time of day for each voiding and whether it occurred on the chamber or in the clothes. The object here was to secure objective data on the functioning of the bladder under ordinary home conditions to further aid in the construction of a training program. In addition, frequency of bladder activity and some indication of success in bladder control were secured from this group. Records were secured on thirty-two infants ranging in age from five and one-half to twenty-seven months.

PRELIMINARY TRAINING GROUP

Six infants, three boys and three girls, ranging in age from seven to sixteen months were subjects for a preliminary experimental study. These infants were observed during the months of May, June, and July, 1930. With this group a definite training program was introduced which emphasized regularity and freedom from distractions. It was at first thought that a definite time schedule, based on the clock, with regular intervals could be followed. The irregularity of the home routine made this plan untenable. Accordingly a schedule based on the daily routine of the child was substituted. This schedule took into account the routine of feeding, bathing, and napping for the particular child. Various record forms and systems of recording were tried.

As a result of this preliminary work the home record form and symbols for recording activity of the bladder, and a plan for recording interferences were perfected; a plan for parent coöperation was formulated; and a tentative training guide for bladder control was evolved. In its initial stage the training guide was a compilation of instructional material on training for bladder control taken from reputable medical and psychological sources.

MAIN TRAINING GROUP

In the main experiment the plan was to reach mothers with infants ranging from three to eighteen months of age who were willing to coöperate in a training program for bladder control. The most successful plan as determined from the preliminary work was to gain the coöperation of the mothers making use of the Nutrition

Clinic and Infant Laboratory of the Station. Generally, it may be said that the mothers making use of the above clinics are a selected group from the point of view of interest in the welfare of their children and willingness to coöperate in a project involving their child. The coöperation of the mother having been secured through an interview, an initial home consultation was arranged at which time the purpose of the study, the instructions for training, and the record forms were carefully explained. In homes where certain interference factors were present they were removed or their effects reduced as much as possible. A schedule for bladder training (and bowel training if no previous training had taken place) was then constructed based on the daily routine of the child. Usually the schedule provided that the infant should be handled for toilet routine, either before or after other routines such as bathing, feeding, napping, and outdoor periods. These periods were indicated on the time line of the record sheet which was conveniently placed in the bathroom or in close proximity to the toilet. In general, the number of times an infant was placed on the toilet for the day was held constant.

When infants had no previous training in the control of either bowel or bladder and were unconditioned to responding when placed on the chamber, a preliminary observation period of a few days was made to determine the most favorable time for bowel evacuation and to determine the approximate number of daily voidings. With the aid of a soap stick or suppository, a device with which most mothers are familiar, the bowel movement was initiated following which the child was placed in contact with the chamber. Ordinarily within a few days the child responded following contact with the chamber only. Urination occurred usually with each bowel evacuation and the child was gradually conditioned to the use of the chamber for this function as well.

At intervals of ten to fourteen days the homes were visited for a conference with the mothers for the purpose of estimating and facilitating progress. During these interviews attempts were made to adjust difficulties, to clarify training directions, and to suggest improvements in record keeping. Each interview was previously arranged by telephone. Often aid could be given the mother by telephone rather than by personal call at the home.

Following each interview or consultation a notation covering the points considered in the interview was made. The notes aimed to provide a more accurate description of the cases in the study and of the home conditions which interfered with or facilitated progress in training.

Thirty-nine infants were studied in this group, three of whom had too little data reported to be included in the final treatment of the data. Among this group of thirty-six infants twenty-one were boys and fifteen were girls; these infants ranged in age from twelve to eighty-four weeks. The period of observation varied from four to thirty-two weeks, the average observation period being fifteen weeks.

Near the end of the experimental period a medical examination was given to each infant in the directed group by a competent pediatrician for the purpose of discovering any abnormalities. No physical conditions were found that were thought to militate against gaining control of the bladder function. Among the thirty infants that were examined twenty-one were rated as being in excellent health, eight as being in good health, and one as being in fair health.

Physical measurements were administered near the end of the observation period. The physical measurements revealed but small deviations from the norms in each of fourteen measurements taken, seven of which were reported to parents.

The Station Tests for Young Children, which are in process of standardization and are designed to measure mental development, were administered to thirty-five of the infants of the directed group. Twenty infants were rated as above average, thirteen as average, and one as below average on this test. The ratings on the tests are based on tentative norms and are not considered sufficiently reliable for correlation with other measures. These examinations served to provide a more accurate description of each case as well as to provide a general estimate of the nature of the group.

Laboratory Group

A laboratory group of seventeen male infants, kept at the Children's Hospital of the University and the Station Nutrition Laboratory for research work in metabolism, were available for the purpose of investigating certain factors relative to the functioning of the automatic or involuntary bladder. The infants in this group ranged in age from two to thirteen months. At intervals of two weeks these infants were placed on metabolism frames for a period of seventy-two hours. While the infants were on these frames the frequency, interval, and amount in cubic centimeters of voidings were determined. At other times the frequency and interval were observed and checked. These infants were observed for varying periods of a day, two days, and three days in the months of March, April, May, June, and July of 1931. They were under the care of graduate nurses, and uniform controlled conditions generally obtained. All observations on the infants of this group were made by the writer.

The data for this study, then, have been gathered from five groups of subjects: (1) a questionnaire group of 172 children under four years, (2) an undirected group of thirty infants ranging in age from five and one-half to twenty-seven months, (3) a preliminary directed group of six infants ranging in age from seven to sixteen months, (4) the main experimental or directed group of thirty-six infants from three to twenty months, and (5) a laboratory group of seventeen male infants in metabolism wards ranging in age from two to thirteen months. The results of this study consequently are based on the observation of over 250 infants.

RELIABILITY OF OBSERVATIONS

QUESTIONNAIRE

A critical evaluation of the use of the questionnaire for research in psychology has been made by Ruckmick (40). The weaknesses of the questionnaire method according to Ruckmick are five: (1) the stress which is placed on categorical answers, (2) the uncontrolled nature of the replies, (3) the uncertainty of interpretations placed on results, (4) the abuse of statistical treatment of doubtful data, and (5) the oversight of unreturned forms and unfilled blanks. The advantages given are: (1) the saving of time and scope of inquiry, (2) the possibilities of furnishing cues, and (3) the forethought required in scrutinizing the general field for investigation. He views the use of the questionnaire as a prescientific procedure. The present questionnaire has been used in this sense. Specifically it was used in this study to furnish facts as to the existing home practices and problems in training for elimination before the experiment was begun. An attempt was made to use categories as concise and free from ambiguities as possible and to deal with material having a factual basis. Only mothers with children under four years were asked to fill the questionnaire. There were no unreturned blanks inasmuch as they were filled by the mothers while attending a session of their club work or while attending the Infant Research Laboratory of the Station. Unanswered items were usually due to the child being too young and the item, therefore, did not apply. No statistical treatment was made of the questionnaire returns other than to classify the data and to estimate in numerical terms the importance of the items. It is believed that no other device would have proved so satisfactory and economical in gathering this preliminary information as did the questionnaire.

UNDIRECTED GROUP

The collection of objective data, such as was made by the use of a three day record blank of bladder activity, has definite limitations. In the first place, considerable time is involved on the part of the mother in making such observations; in the second place, few mothers will coöperate in a project the worth or purpose of which is little known to them. The purpose in the use of this form was first, to sample the bladder activity for frequency and interval in the case of infants who had been given no particular training for bladder control, and second, to make comparisons with data from other groups.

The returns on this form were less satisfactory than on the questionnaire in spite of the fact that forms were given only to mothers who stated a willingness to make observations over a three day period. The returns, thirty-two in number, represent approximately one-third of the total number of forms distributed. The items observed by the mothers were of an objective nature, such as recording time of day, voiding in clothes and in the chamber. Moreover, an examination of the records shows that there is a consistency in frequency and number of hours from day to day.

DIRECTED GROUP

In the selection of the forty-two mothers, comprising the preliminary and main directed groups, who stated their willingness to enter into a training program for bladder control approximately a hundred were interviewed. Numerous reasons were given for unwillingness to coöperate. Among them were: the early age of the child, a desire to wait until the child was old enough to understand, lack of time on the part of mother, mother's preference for doing laundry or having maid do it, etc.

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Previously a technique for observing and recording progress in bladder training had been evolved. At the time of the initial home interview, recording materials and uniform instructions were given mothers. Efforts were made to minimize the time involved in routine of training and in record keeping. Here as in the previous group the information called for was highly objective, i.e., whether a child has wet clothing or is successful on the toilet is not a speculative matter. It did happen, however, that in the early weeks a few mothers failed to record all observations made either because of lack of time or of desire to make the best possible showing for their children. Usually in such cases the failure was in recording all times the child was found wet. Instances where this was known to occur were in the initial records of Cases F20, F25, M30, and M31. In each of these cases the curve of learning decreases following the first or second week of observations due to failure to record all observations. Usually following the second or third home interview the objectives of the study were more clearly understood by the mother and accordingly the observations were more systematic.

The consistency of the data in general is probably the best single measure of the reliability of the observations. An examination of the original data indicates high regularity in the recording of the data on bladder activity week by week except for such data as represent a sampling of the week.

TREATMENT OF DATA

Criteria of Control

In order to estimate the effects and progress of training of the thirty-six infants in the directed group two criteria of success were used: (1) the ratio of successes to the total number of placements on the chamber, and (2) the ratio of successes to the total number of voidings. In this study the first index is referred to as the *plus-minus ratio* and the second as the *plus-wet ratio*. While these two measures are definitely related to one another and in part are a measure of the same process, the former is used as a measure of the infant's ability to void when placed on the chamber and the latter as the infant's ability to retain the urine during the interval. Physiologically, the plus-minus ratio may be thought of as the ability to relax the muscles of the sphincters involved in micturition and the second as the ability to maintain contraction over the muscles of the sphincters. These same measures were used for estimating the level of control of the infants in the undirected group.

TIME UNITS

Two classes of time units were evolved to estimate the progress in gaining bladder control: (1) the week unit of seven days, and (2) the periods of initial and later progress. The reasons for using successive seven day units for showing progress seems obvious. Routine measures in the home reoccur on the weekly basis. Social institutions move in cycles of seven days duration. Furthermore, a definite change in progress in the initial period of training could be shown by the use of this unit. That there are initial and maintenance periods in gaining control of the bladder function has been determined empirically. In general, the initial period, or period through which significant successive gains are made, extends over the first six weeks. The maintenance period extends from this point on with slight but insignificant gains from week to week. With the other groups changes in status were estimated by use of monthly time units.

THE USE OF CASE AND STATISTICAL PROCEDURE

Individual data and notes on each case used in the training group were made.

In the analysis of these data the case method and the statistical method were used. Obviously both methods have advantages and limitations. A more elaborate discussion of the relative merits of these two methods has been made by White (48). Numerical data which are subject to selection and segregation were treated statistically. Nonquantitative and sequential data were treated by the case method. In this study these two methods are considered as supplementary. A graphic presentation of results has been used throughout this study when possible.

Two statistical procedures were available for use in this study, one for calculating the gain or loss in the case of correlated measures and the other for calculating the significance of two means for independent samples. A discussion of the two procedures is given by Fisher (17).

For the separation of infants on the basis of certain factors affecting progress during the initial period, the general treatment is as follows: The infants were divided into two groups, the gains made by the infants in one group were found, the mean and standard deviation calculated, and the formula for calculating the significance of a mean applied. The t value derived was then referred to Fisher's formula (See fourth formula in tabulation on page 25) for its P value. If one group showed a larger gain than the other, the formula for calculating the significance of the differences of two means was applied to show whether or not one average gain was significantly larger than the other. In each case two complete comparisons were made, one for the plus-minus ratio and the other for the plus-wet ratio. For the comparison of two groups as to maintenance levels, the average for a series of four weeks was taken for each infant. This gave an array of infants' averages for each group. The average maintenance level was found for each group from these series of averages, and two means were then compared by the formula for calculating the significance of two means for independent samples to find whether or not one was significantly greater than the other.

In two cases two maintenance levels of the same infants were compared. The average for one four week period was subtracted from the average for a second four week period. This array of differences was then used with the formula for the significance of a mean to find whether the average difference was significantly greater than zero.

In each case the values of t and n were referred to Fisher's formula (See tabulation on page 25) for the P value. The value P is the probability that the obtained value is a chance one, i.e., if the time condition is such that some subjects made large gains while others made small gains and the average is neither gain nor loss, the P value then for any given n and t represents the chances in 100 that the value t would be reached or exceeded in drawing random samples of the sizes used.

The subjects of this study were identified and referred to by number and letter. Each subject was given a number before which appears the letter M or F to denote the sex of the child: F35, for example, is a female infant whose number is 35, M7 a male infant whose number is 7, etc.

STATISTICAL PROCEDURES

In the statistical treatment of the data of this study five procedures are available. These procedures may be exemplified by the problem presented in the following tabulation which contains the plus-minus indices of bladder control for twenty-three infants during the first and the sixth week of training. The gain or loss values for the above interval are given in the fourth column.

Child	First Week	Sixth Week	Gain or Loss
M1	33.0	97.6	+64.6
F6	85.0	85.5	+ 0.5
M7	52.2	53.8	+ 1.6
M8	63.6	72.2	+ 8.6
M9	57.7	63.5	+ 5.8
M10	61.4	71.9	+10.5
M12	73.2	80.0	+ 6.8
M13	64.5	89.6	+25.1
F14	23.8	50.0	+26.2
M15	55.0	100.0	+45.0
M16	6.7	59.5	+52.8
F18	7.4	17.5	+10.0
M21	75.3	87.2	+11.9
F23	26.9	70.9	+44.0
F24	38.8	41.8	+ 3.0
F25	87.5	96.1	+ 8.6
M27	10.5	89.5	+79.0
M29	86.7	100.0	+13.3
F33	78.4	86.4	+ 8.0
F34	65.4	84.4	+19.0
F35	72.9	70.8	— 2.1
F37	59.6	79.6	+20.0
F39	70.7	89.5	+18.8

The five procedures are represented by three formulas for calculating the standard error of differences and two for calculating gain or loss. The five formulas are given below:

$$\sigma\,(\text{diff.}) = \sqrt{\sigma^2_{(\text{av. }1)} + \sigma^2_{(\text{av. }2)}} \quad \text{(Garrett, 19)}$$

$$\sigma\,\text{av. d.} = \sqrt{\sigma^2_{\text{av. }x_1} + \sigma^2_{\text{av. }x_2} - 2r\sigma_{\text{av. }x_1}\sigma_{\text{av. }x_2}} \quad \text{(Garrett, 19)}$$

$$\sigma\,\text{av. d.} = \frac{\sigma\,(\text{dis. d.})}{\sqrt{N}} \quad \text{(Garrett, 19)}$$

$$\frac{s^2}{n'} = \frac{1}{n'(n'-1)}\,S\,(x - \bar{x})^2,\ t = \frac{\bar{x}\sqrt{n'}}{s},\ n = n' - 1 \quad \text{(Fisher, 17)}$$

$$s^2 = \left(\frac{1}{n_1+1} + \frac{1}{n_2+1}\right) = \frac{(n_1+n_2+2)}{(n_1+1)(n_2+1)(n_1+n_2)}\left\{S\,(x-\bar{x})^2 + S\,(x'-\bar{x}')^2\right\}$$

(Fisher, 17)

$$t = \frac{\bar{x} - \bar{x}'}{s}\sqrt{\frac{(n_1+1)\ (n_2+1)}{n_1+n_2+2}} \quad \text{(Fisher, 17)}$$

$$n = n_1 + n_2 \quad \text{(Fisher, 17)}$$

CHAPTER III

RESULTS AND DISCUSSIONS

The four groups of data on which this study is based will be considered in the following order: (1) the directed group; (2) the questionnaire; (3) the undirected group; and (4) the laboratory group.

THE DIRECTED GROUP

THE INITIAL AND MAINTENANCE PHASE OF BLADDER CONTROL

In this study the initial period has been defined as the period during which significant weekly gains were made by the group as a whole. The maintenance period is the period during which no significant weekly gains were made. The general nature of these two periods on both the plus-minus ratio and plus-wet ratio can be seen in Figure 1. In Chapter II it was shown that significant weekly gains were made for the group as a whole. Throughout this section the various factors will be analyzed on the basis of these two periods in order to follow the progress made in gaining bladder control.

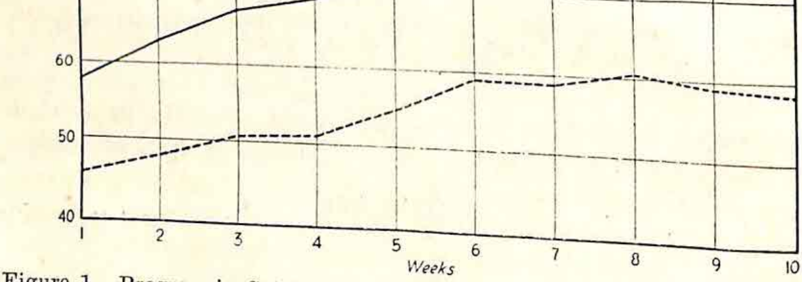

Figure 1. Progress in Gaining Bladder Control in Thirty-Six Infants During the First Ten Weeks of Observation (Plus-Minus Ratio ——, Plus-Wet Ratio — — —)

Relation of Age to Bladder Control

Initial Period

In order to determine the relation of age to the initial period of training, the thirty-six infants were divided equally into three age groups—a youngest, a middle, and an oldest group (Figures 2 and 3). These groups averaged in age 25.3 weeks, 42.2 weeks, and 62.5 weeks respectively. On the plus-minus ratio the gains over the initial period of six weeks were 14.81, 28.17, and 11.80 respectively. On the plus-wet ratio the gains for the initial period were: youngest 6.96, middle 13.07, and oldest 9.64. The greater gain made by the middle group on both ratios can be attributed in part to the greater proportion of subjects with no previous training having been included in this group. In a later section consideration

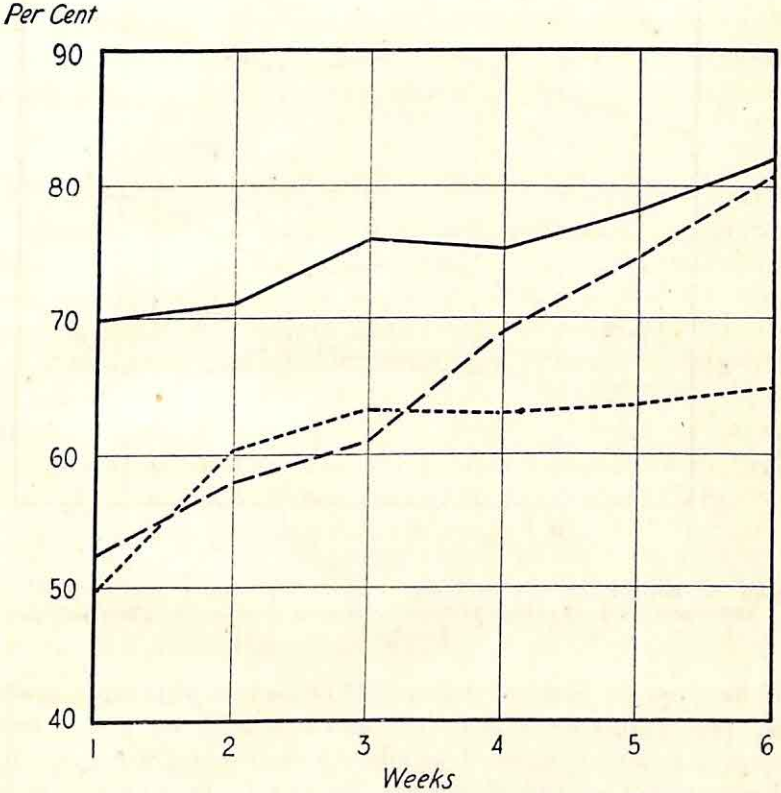

Figure 2. Relation of Age to Initial Progress in Gaining Bladder Control; Significant Gain Made by Each Age Group on Plus-Minus Ratio (Oldest ——, Middle — —, Youngest ....)

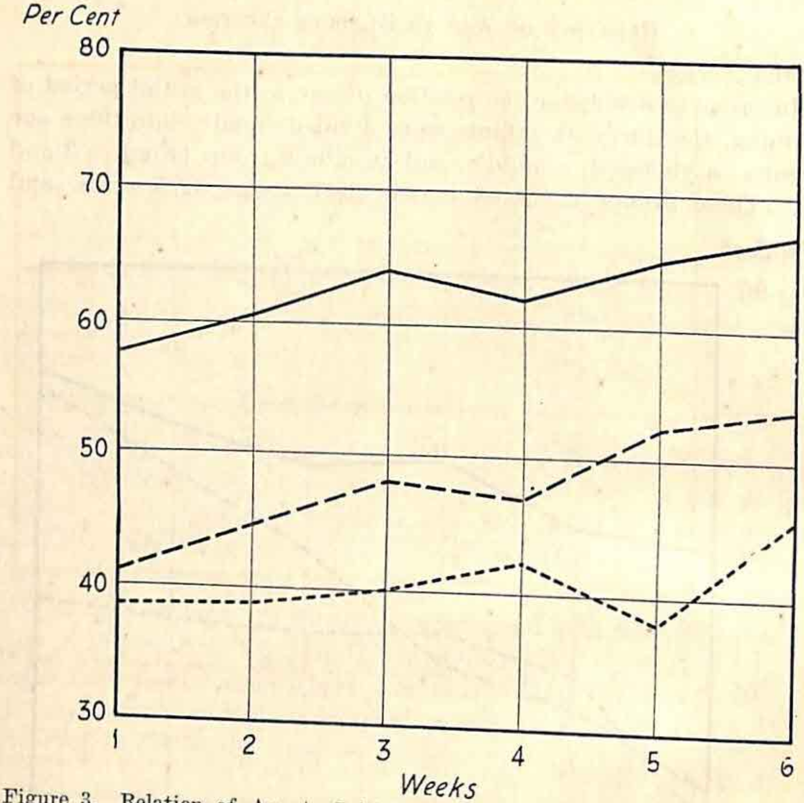

Figure 3. Relation of Age to Initial Progress in Gaining Bladder Control; Difference Not Significant from Group to Group on Plus-Wet Ratio (Oldest ——, Middle — —, Youngest ....)

will be given the problem of the effect of amount of previous training. Segregating the data for all cases into three age groups from youngest to oldest makes it possible to show significant gains for all ages on both criteria of success. The significance in gains ranges from slightly to highly significant, that is, P ranges from .2 to .05.

Maintenance at Four Age Levels

Figures 4 and 5 show the relation of four age levels on both ratios of control to maintenance. The average ages in weeks for these levels are 32.9, 45.5, 58.0, and 76.7. The intervals between represent approximately three months.

The mean maintenance levels for these groups on the plus-minus ratio are: youngest 78.1, second 82.6, third 84.1, and oldest 87.9; while on the plus-wet ratio the means are 58.3, 59.8, 65.2, and 76.4

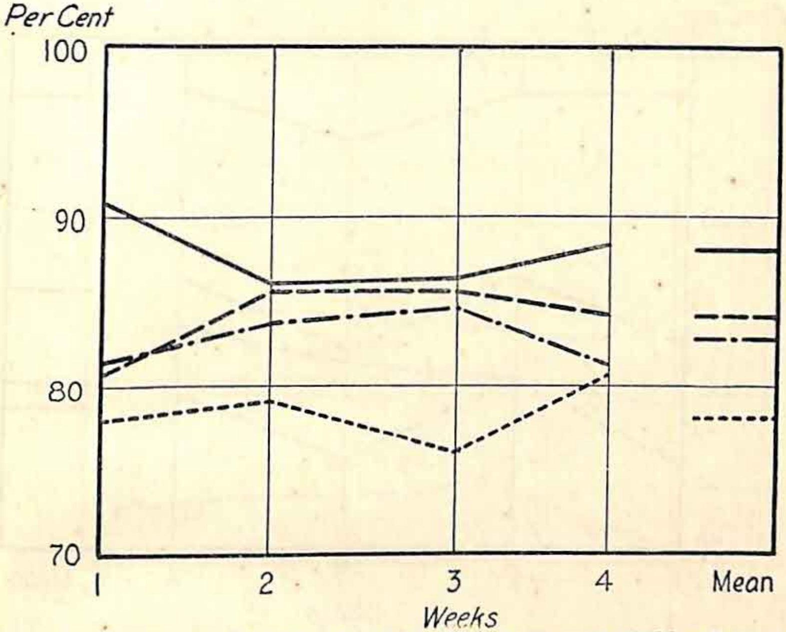

Figure 4. Relation of Four Age Levels to Maintenance of Bladder Control; Difference Insignificant from Level to Level on Plus-Minus Ratio (Oldest ——, Third — —, Second — . —, Youngest ....)

respectively. No significant differences in maintenance were found from age level to age level, but a P value of less than .01 was found between level of youngest and level of oldest group on the plus-wet ratio. This is a significant difference.

Maintenance at Two Age Levels on Same Infants

Further analysis of the relation of age to maintenance was made on the same infants at two age levels (Figures 6 and 7). The average ages for the two levels were 57.4 and 69.9 weeks. By the use of the difference formula for correlated measures both ratios gave a P value of .01, showing a significantly higher maintenance of control in favor of the older age level.

Cost of Maintenance at Two Age Levels

A further indication of the significance of the superiority of control in favor of the older age can be seen in Figure 8 which represents the total trials or placements given the infant on the chamber for each of the two age levels. For the younger age the average number of trials is 59.9 as compared with 55.7 for the

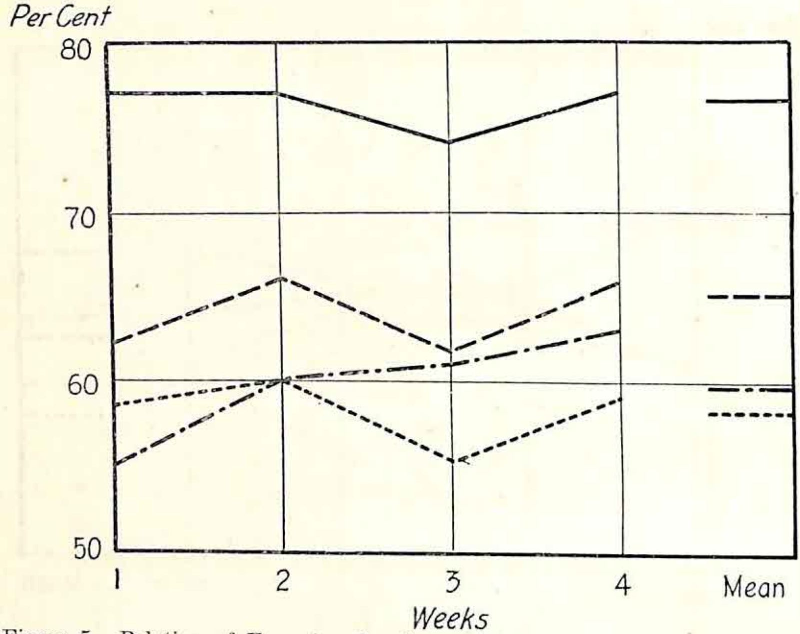

Figure 5. Relation of Four Age Levels to Maintenance of Bladder Control; Difference Insignificant from Level to Level on Plus-Wet Ratio (Oldest ——, Third — —, Second — . —, Youngest ....)

older age. This difference has a P value of .2 which is of only slight significance, yet it lends support to the superiority of the older age level in maintaining control. The conclusion from this analysis is that with the same effort, in terms of trials on chamber, bladder control at the older age can be maintained at a significantly higher level.

RELATION OF INTERFERENCE TO BLADDER CONTROL

In this investigation two types of interference factors are recognized. Factors whose effects are operative over a relatively long period are termed permanent interference factors, while factors with effects of short duration are termed temporary interference factors. Examples of the former are: irregular routine, lack of time on part of mother, inaccessibility to toilet, poor health, or presence of maid or relatives in home. Examples of temporary factors are: teething, colds, illness, trips, and guests in home. The permanent interference factors may be thought of as being largely responsible for plateaus in the progress of control, and the tem-

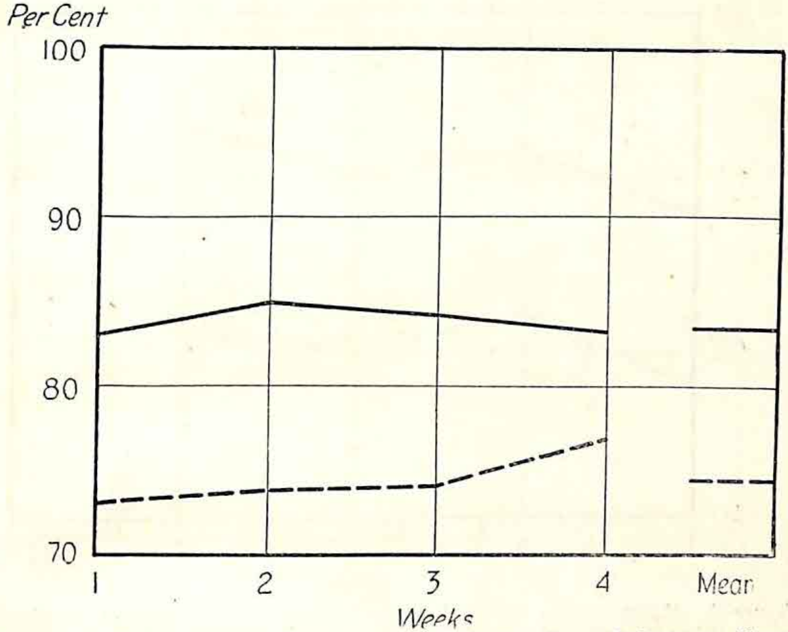

Figure 6. Maintenance at Two Age Levels in the Same Infants as Shown by Plus-Minus Ratio (Older ——, Younger — —)

porary factors causing the short fluctuation in the curve of learning.

Initial Period

For purposes of evaluating the effects of permanent interferences on the initial period of training, the data on the thirty-six infants were separated into two groups, one group with few interferences and the other with many interferences (Figures 9 and 10). The group having few interferences made a gain of 25.9 on the plus-minus ratio and a gain of 21.9 on the plus-wet ratio. The group with many interferences made corresponding gains of 10.6 and –1.1. On both ratios the group having few interferences in the training routine made very significant gains; the P value for these gains are much less than .01 on both ratios. The gain made by the group with many interferences had but slight significance on the plus-minus ratio. The gain on the plus-wet ratio had no significance. The P value in the former case is more than .05, in the latter it is .8. The two groups are fairly well equated for age and starting point.

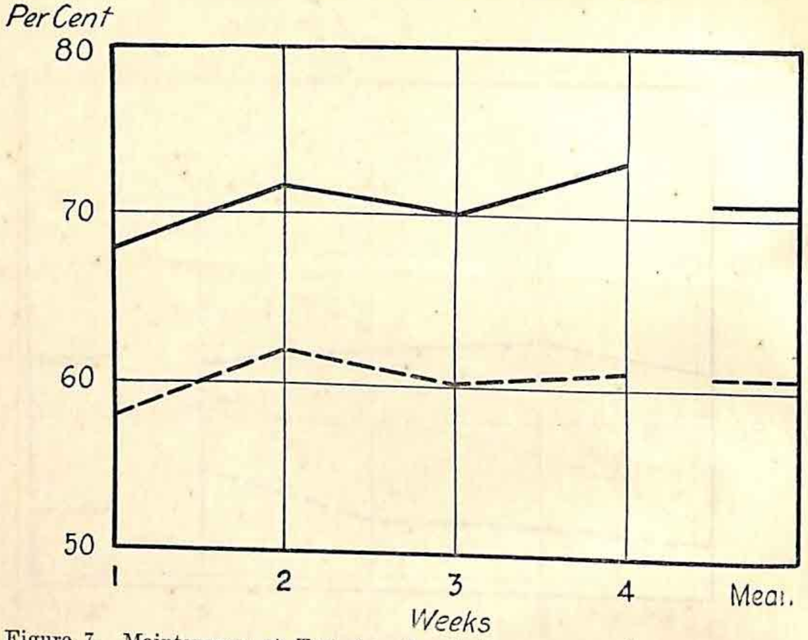

Figure 7. Maintenance at Two Age Levels in the Same Infants as Shown by Plus-Wet Ratio (Older ——, Younger — —)

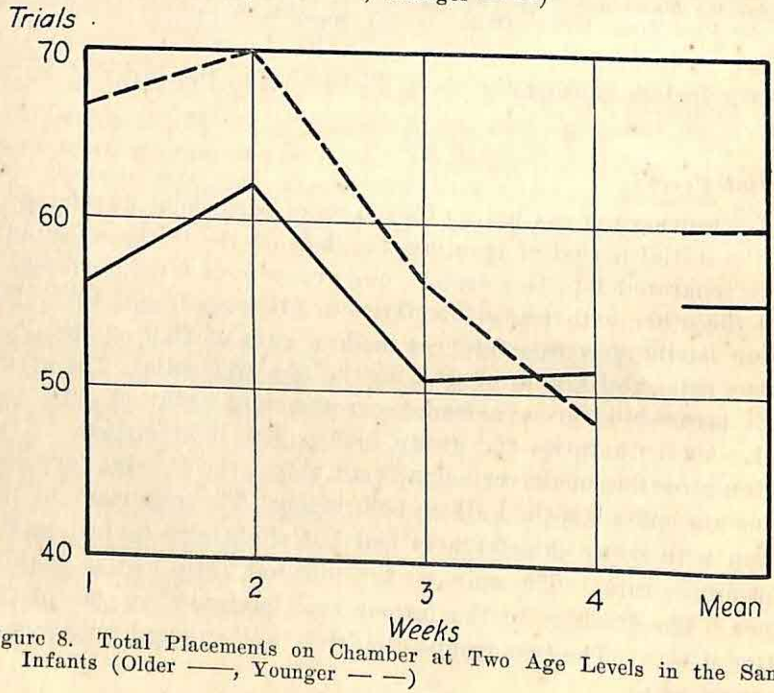

Figure 8. Total Placements on Chamber at Two Age Levels in the Same Infants (Older ——, Younger — —)

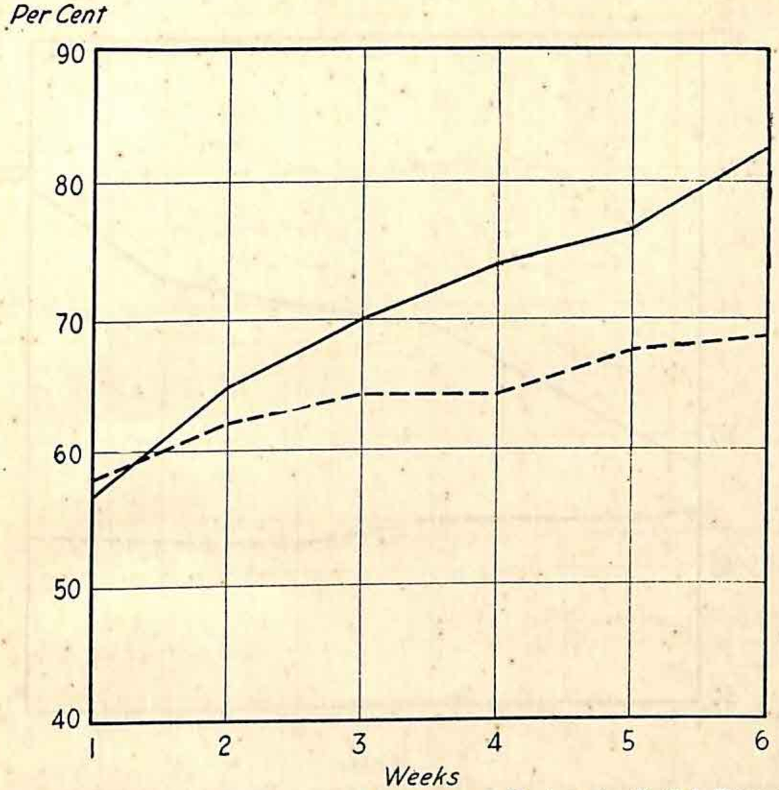

Figure 9. Relation of Permanent Interference Factors to Initial Progress in Gaining Bladder Control as Shown by Plus-Minus Ratio (Few ——, Many — —)

Maintenance Period

Permanent interference factors likewise have a relation to maintenance of control as shown in Figures 11 and 12. Subjects being trained under many interference factors were paired with subjects trained with few interference factors present. The average age was 53.4 weeks for the group with few interferences and 48.4 weeks for the group with many interferences. For the first group the average level is 72.06, for the second it is 55.12, the standard error of the difference of these values being much less than .01 on both ratios. Thus control is maintained at a higher level for the group with few interferences.

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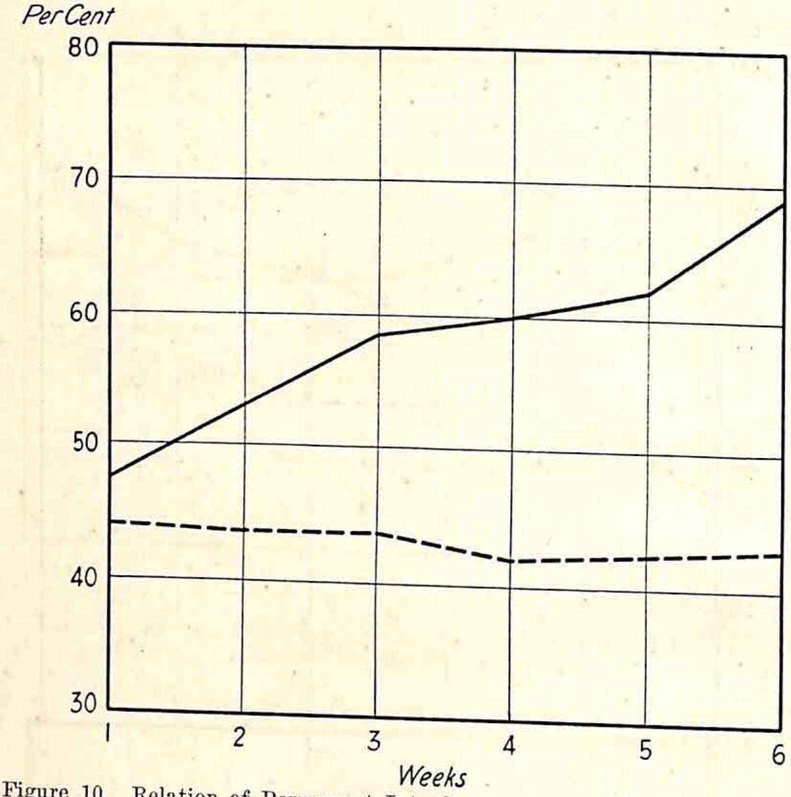

Figure 10. Relation of Permanent Interference Factors to Initial Progress in Gaining Bladder Control as Shown by Plus-Wet Ratio (Few ——, Many — —)

Temporary Interferences

While this study does not aim to isolate or determine the effects of each interference factor, permanent or temporary, it is possible to show conclusively the effects of several single temporary interference factors.

Teething

One such factor is teething. From the protocols and from home records, occurrences of teething for a number of infants were recorded. When teething occurred during the maintenance phase of the training program, the record for the week in which the tooth erupted was compared with that of the week previous to the eruption and the week following the eruption.

The results can be seen in Figure 13. The average drop in degree

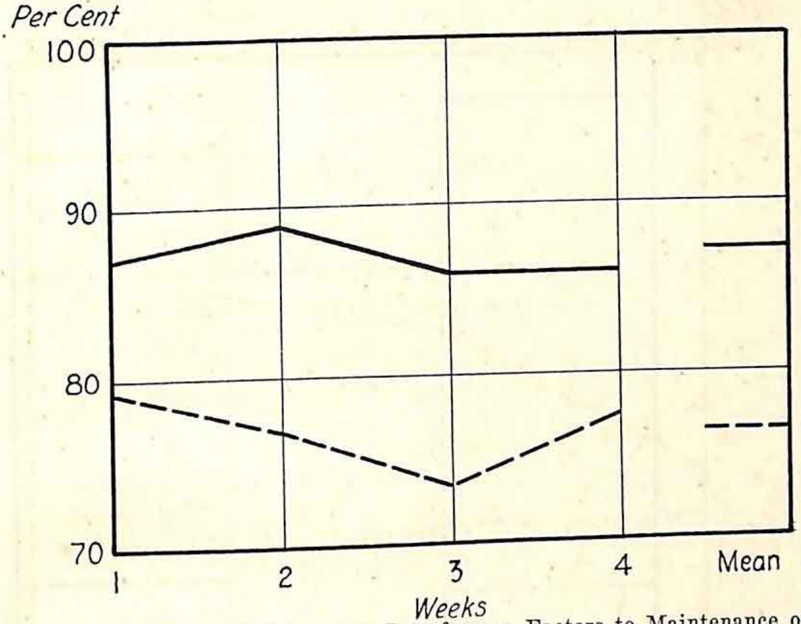

Figure 11. Relation of Permanent Interference Factors to Maintenance of Bladder Control as Shown by Plus-Minus Ratio (Few ——, Many — —)

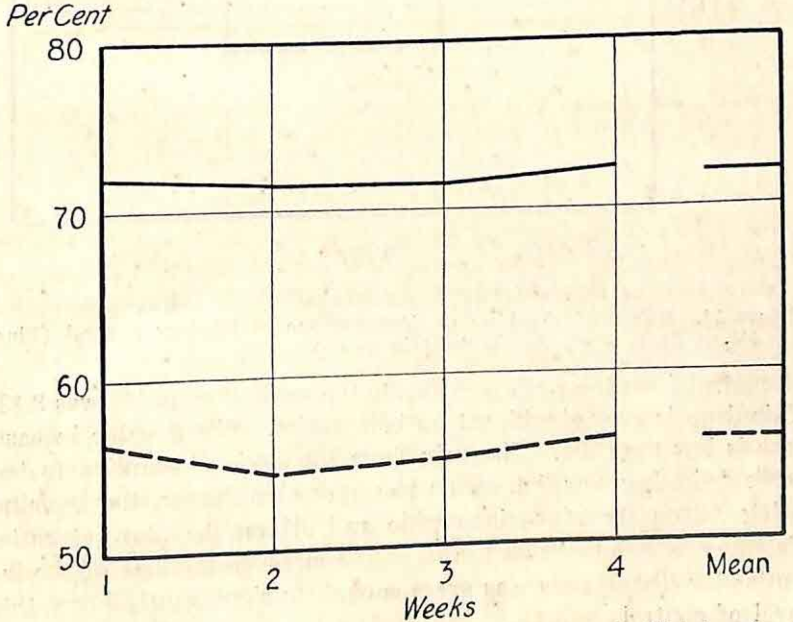

Figure 12. Relation of Permanent Interference Factors to Maintenance of Bladder Control as Shown by Plus-Wet Ratio (Few ——, Many — —)

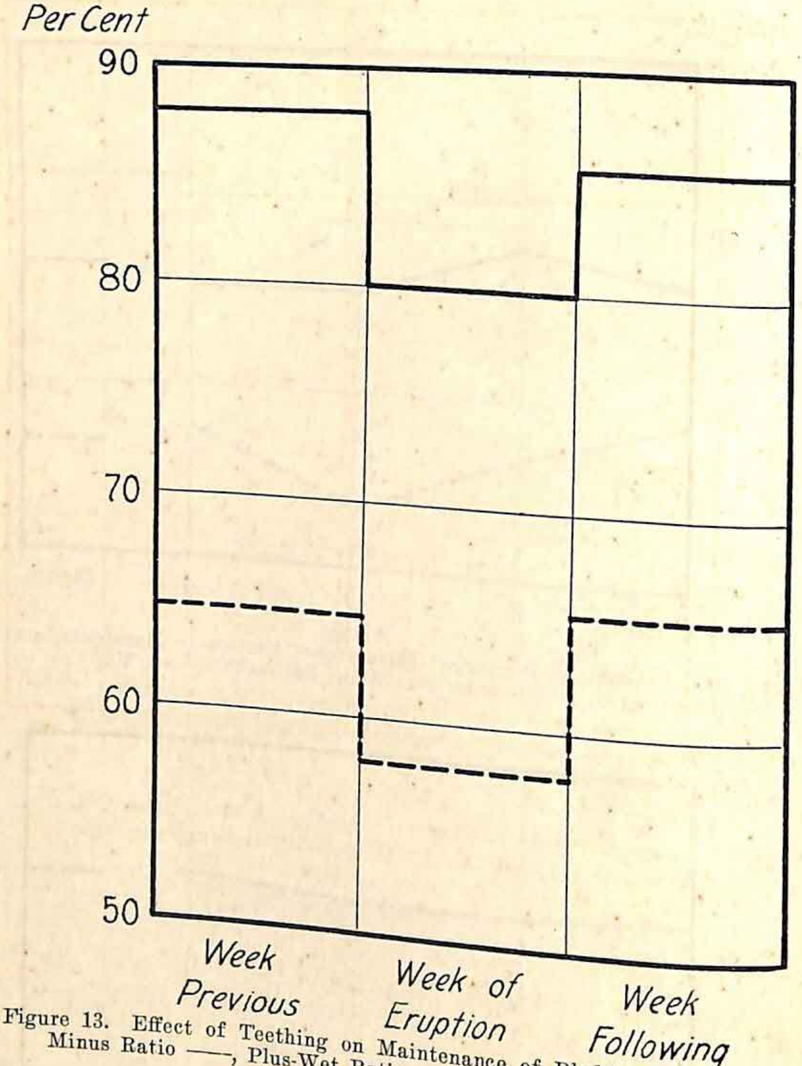

Figure 13. Effect of Teething on Maintenance of Bladder Control (Plus-Minus Ratio ——, Plus-Wet Ratio — —)

of control from the week previous to the week of eruption was 8.13. This drop is very significant on both ratios. The P value in each case is less than .01. The gain from the week of eruption to the week following was 5.6. This has high significance, the P value being .02 on the plus-minus ratio and .01 on the plus-wet ratio. Teething definitely alters the level of control in the case of the infants; the disturbance was great enough to significantly lower this level of control.

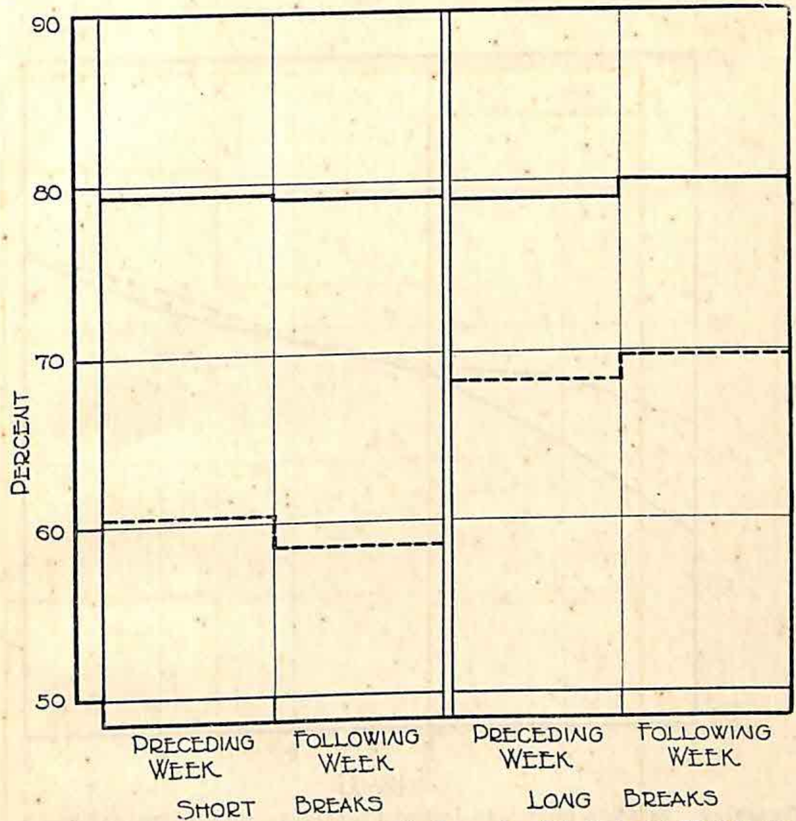

Figure 14. Effects of "Breaks" in the Records of Infants on Maintenance of Bladder Control (Plus-Minus ——, Plus-Wet Ratio — —)

Breaks in Record

Breaks in the recording of observations likewise may be considered as an interference factor of a temporary nature. Short breaks were those of only one and two weeks duration while long breaks were those of three to ten weeks duration. Figure 14 shows that failure to record observations does not significantly alter the status of the infant's bladder control. It will be noted that a slight drop in level of control follows a short break while for long breaks a slight rise occurs. During the period in which observations were not recorded, training is supposedly continued despite the conditions unfavorable to record keeping. Infants then responded to training immediately upon resuming systematic observations.

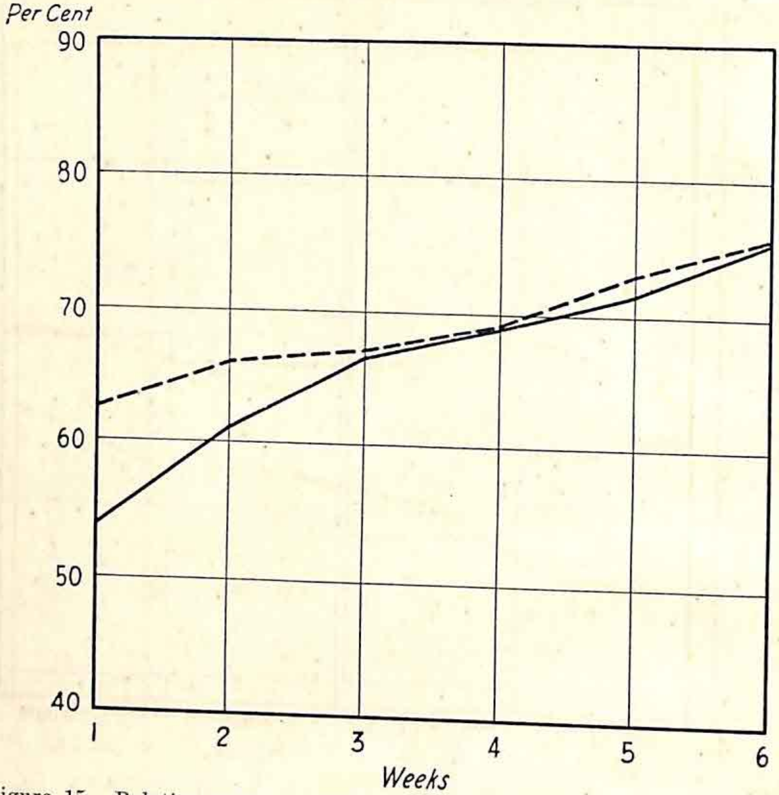

Figure 15. Relation of Sex to Initial Progress in Gaining Bladder Control for All Cases on Plus-Minus Ratio (Male ——, Female — —)

A temporary break in record keeping did not result in a breakdown in training for the infants of this study.

RELATION OF SEX TO BLADDER CONTROL

Initial Period

Data for all infants were segregated on the basis of sex (Figures 15 and 16). Twenty-one subjects of the directed group were boys and fifteen were girls. Their average ages are 38.6 and 49.3 weeks respectively. The starting point is higher for girls than for boys. The average gain for boys is 21.62 with a P value much less than .01, while that of girls is 13.56 with a P value much less than .01. The apparent greater gain made by boys can be accounted for on the basis of difference in starting age and amount of previous training.

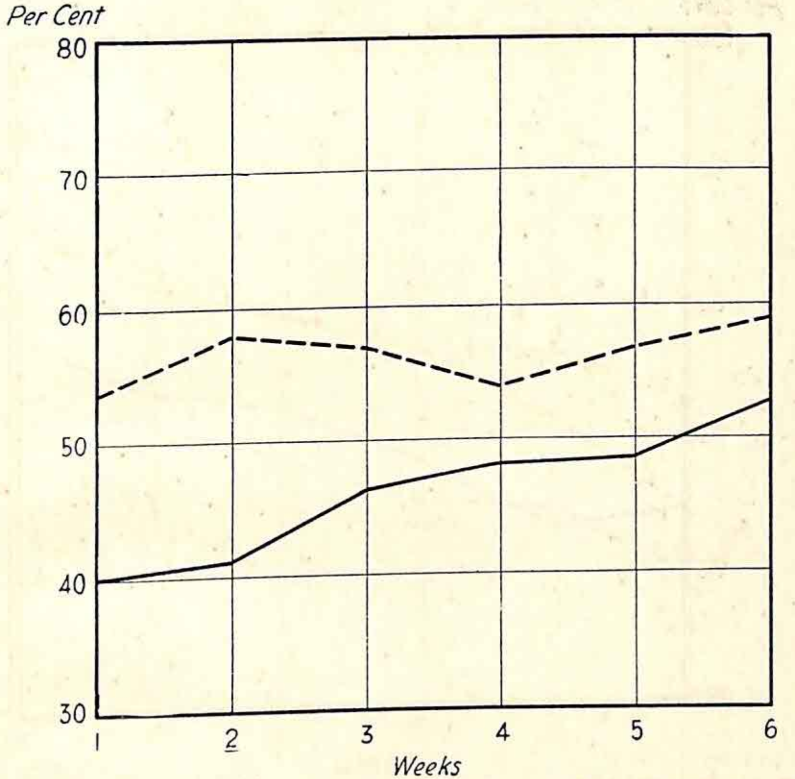

Figure 16. Relation of Sex to Initial Progress in Gaining Bladder Control for All Cases on Plus-Wet Ratio (Male ——, Female — —)

Further analysis of the relation of initial gain in control to sex may be made by equating for age, starting point, and amount of previous training (Figures 17 and 18). When this is done each sex is seen to make significant gains, but on neither ratios were significant differences in gain found. On the plus-minus ratio the average difference is .01; on the plus-wet ratio it is .88. These average differences in gains between boys and girls are exceedingly small. Attention should be called, however, to the greater deviation in performance in boys. The standard deviation values for boys were 20.7 and 18.9 as compared with 11.6 and 11.6 for girls.

Maintenance Period

During the maintenance period with age held constant (Figures 19 and 20), the average difference in gains for boys and girls is

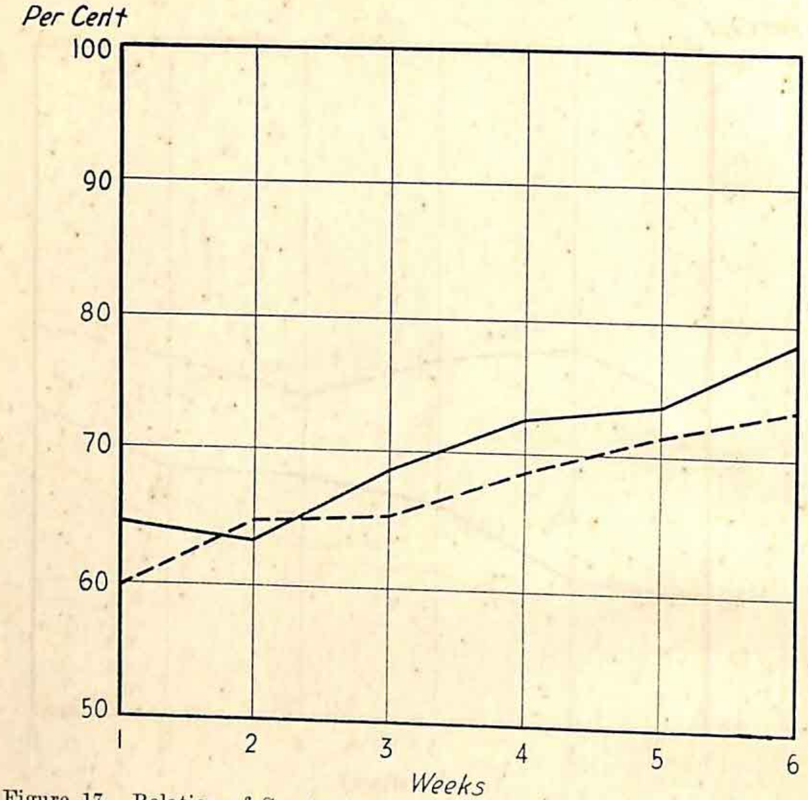

Figure 17. Relation of Sex to Initial Progress in Gaining Bladder Control as Shown by Plus-Minus Ratio of Equal Groups (Male ——, Female — —)

only 1.05 on the plus-minus ratio. On the plus-wet ratio the average difference is 6.70. The P value of this last difference is less than .2, indicating slight significance between boys and girls during the maintenance period.

Relation of Number in Family to Bladder Control

Initial Period

Of the thirty-six cases, eighteen were from families of one child and eighteen were from families of more than one child. With this grouping the results obtained are of value in showing performance of infants under varying home conditions. Whatever the differentiating factor is, the only child makes a much greater gain on the plus-wet ratio than does the child with one or more siblings

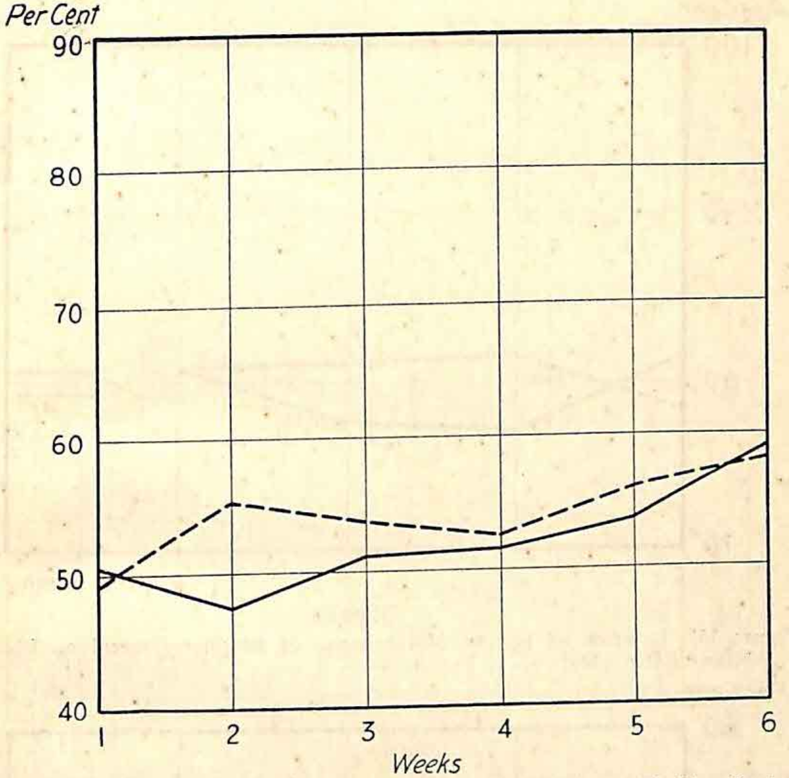

Figure 18. Relation of Sex to Initial Progress in Gaining Bladder Control as Shown by Plus-Wet Ratio of Equated Groups (Male ——, Female — —)

(Figures 21 and 22). The average gain for the former on this plus-wet ratio is 15.06, while for the latter the gain is 3.68. On the plus-minus ratio the gains were large for both groups. These data show that performance is at a higher level for the "only child" group. The number of children in the home is probably not the real reason for the differences found in the two groups. The results may better be used as an interpretation of the home conditions such as amount of time a mother with one child has to devote to a training program as compared with a mother with two children. The data on this point are inconclusive.

Maintenance Period

On the maintenance side the "only child" group shows superior control over the "two or more" group on both ratios (Figures 23

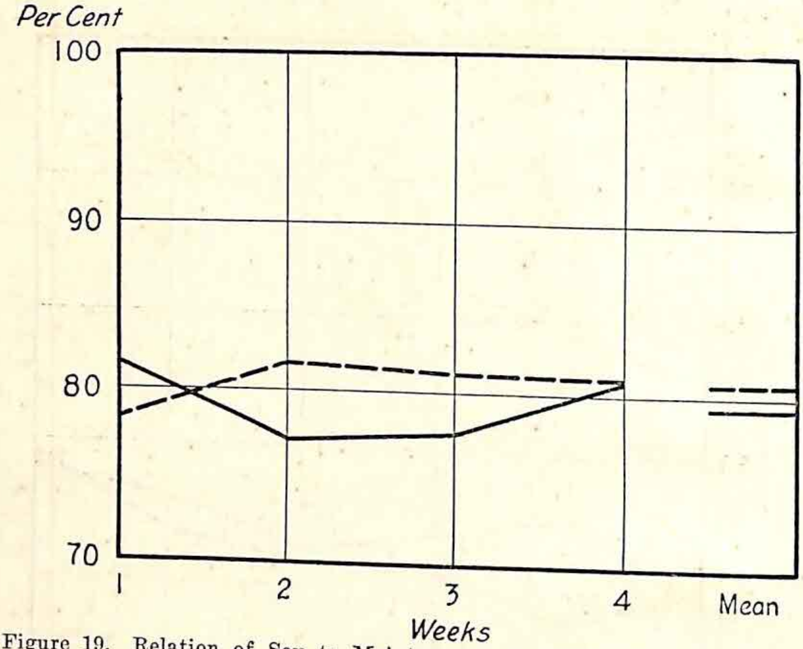

Figure 19. Relation of Sex to Maintenance of Bladder Control on Plus-Minus Ratio (Male ——, Female — —)

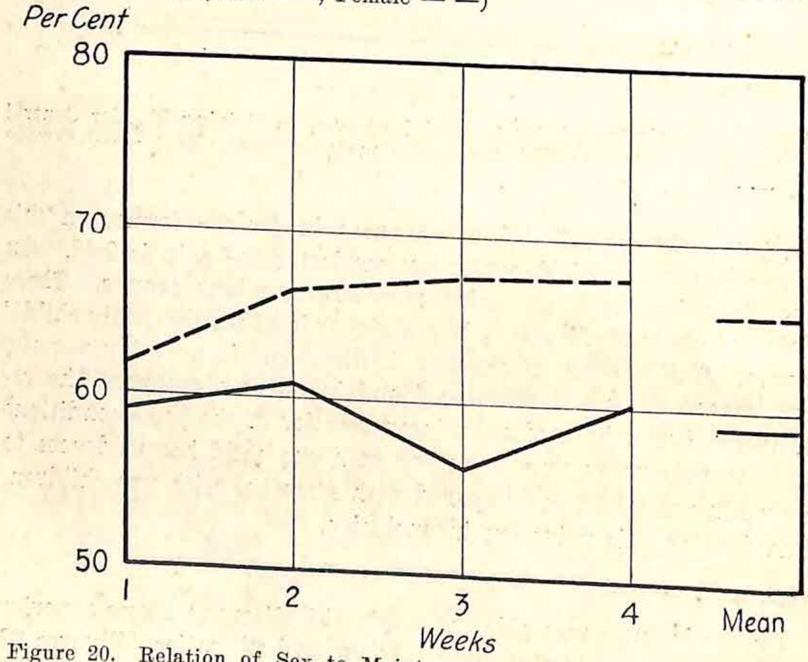

Figure 20. Relation of Sex to Maintenance of Bladder Control on Plus-Wet Ratio (Male ——, Female — —)

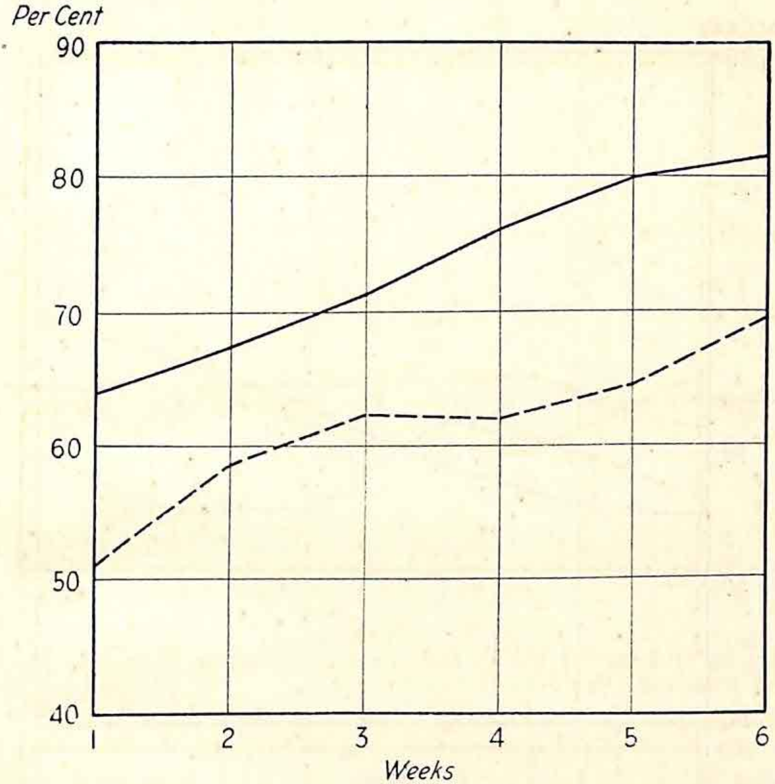

Figure 21. Relation of Number in Family to Initial Progress in Gaining Bladder Control on Plus-Minus Ratio (Only Child ——, Two or More — —)

and 24). In the case of the plus-minus ratio the difference in level is 7.77 per cent. On the plus-wet ratio the difference is 6.15. Both of these differences are in favor of the "only child" group. The predictive value on the plus-minus ratio is less than .01 and on the plus-wet the value is .30.

By the use of both criteria of success, the only child shows progress equal to or superior to that of infants with siblings. This is true for both the initial periods and the maintenance period. The differences noted here are not held to be due to the "only" factor, but rather due to factors common to the homes represented by the two groups of infants.

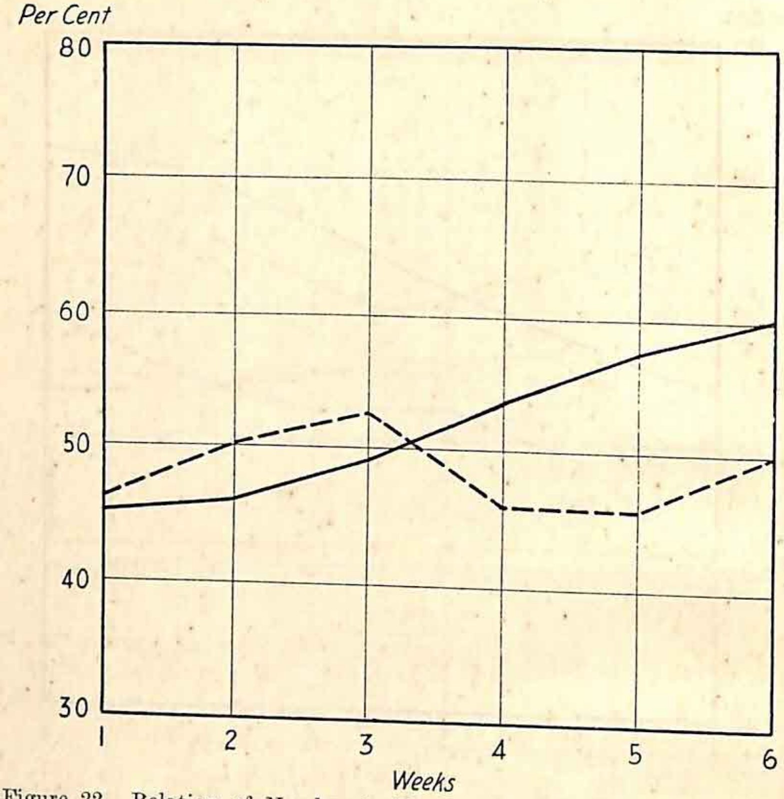

Figure 22. Relation of Number in Family to Initial Progress in Gaining Bladder Control on Plus-Wet Ratio (Only Child ——, Two or More — —)

REGULARITY OF OBSERVATION TO BLADDER CONTROL

Initial Progress

By regularity is meant the consistency of recording observations on the part of the parent. Such consistency is shown in the length of time over which observations were kept and the diligence with which observations were made from day to day and week to week. Regularity should be considered in terms of degree, i.e., home routine is not entirely regular or irregular. Accordingly, on the basis of the above factors the data were segregated into regular and less regular groups (Figures 25 and 26). Nineteen subjects had data recorded which were very regular, while seventeen subjects had less regular to definitely irregular observations.

The results here duplicate those obtained by separating the sub-

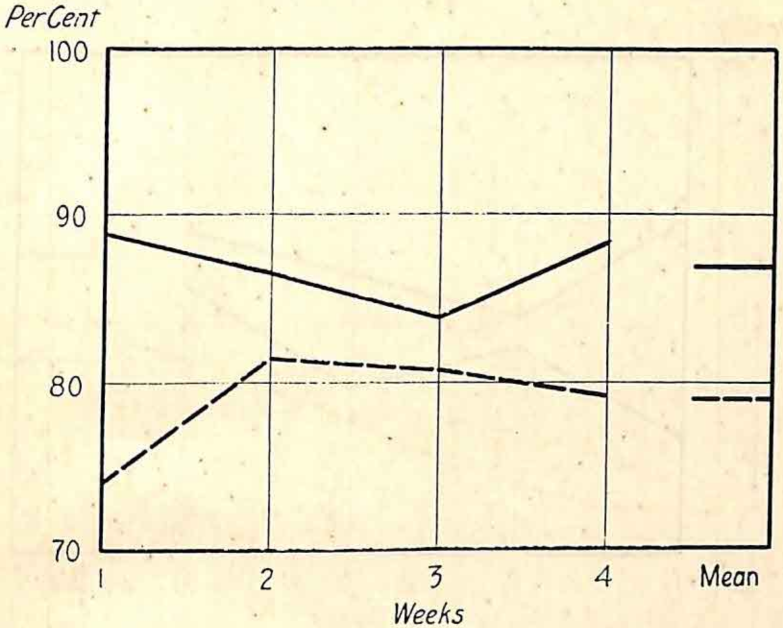

Figure 23. Relation of Number in Family to Maintenance of Bladder Control as Shown by Plus-Minus Ratio (Only Child ——, Two or More — —)

jects on the basis of interference factors, for the subjects of these two problems overlap. The reason for this condition is apparently due to the identity of the problems. Numerous interference factors in the home reduce the opportunities for systematic observations.

The difference in ages in the "regular" and "less regular" groups is only .6 of a week. On both ratios the regular observation group made very significant gains. The less regular observation group made a fairly significant gain on the plus-minus ratio, but was practically on a plateau throughout the initial period of six weeks. The average gain for the regular group was 22.06 on the plus-minus ratio and 17.71 on the plus-wet ratio. The P values of these gains over the less regular group are much less than .01. The less regular group made average gains of 14.01 on the plus-minus ratio and 1.7 on the plus-wet ratio. The P values are respectively .02 and .7.

Maintenance Period

Figures 27 and 28 show graphically the average maintenance level over a four week period for the two groups on the plus-minus

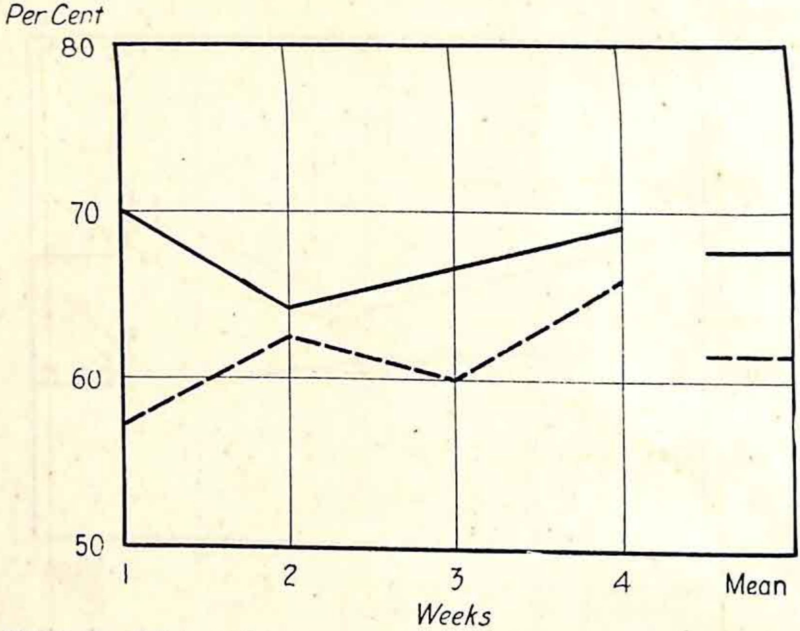

Figure 24. Relation of Number in Family to Maintenance of Bladder Control as Shown by Plus-Wet Ratio (Only Child ——, Two or More — —)

and the plus-wet ratios, respectively. The maintenance levels for the two groups on the first ratio are 85.4 and 75.4, while on the second ratio the levels are 68.8 and 54.3. In each case the superiority of level of control is in favor of the regular observation group. The significance of this gain on the plus-minus ratio is indicated by a P value of less than .05, while on the plus-wet ratio the P value is less than .01. As in the case of few versus many interference factors on maintenance, the regular versus the less regular observation group shows maintenance at a significantly higher level in favor of the former when groups are equated for age.

Relation of Amount of Previous Training to Bladder Control

Initial Period

The thirty-six subjects were classified as to whether or not previous training had been given (Figures 29 and 30). Twelve infants were known definitely to have been given no previous training for bladder control. These two groups are not comparable on either ratio for several reasons, mainly the large difference in

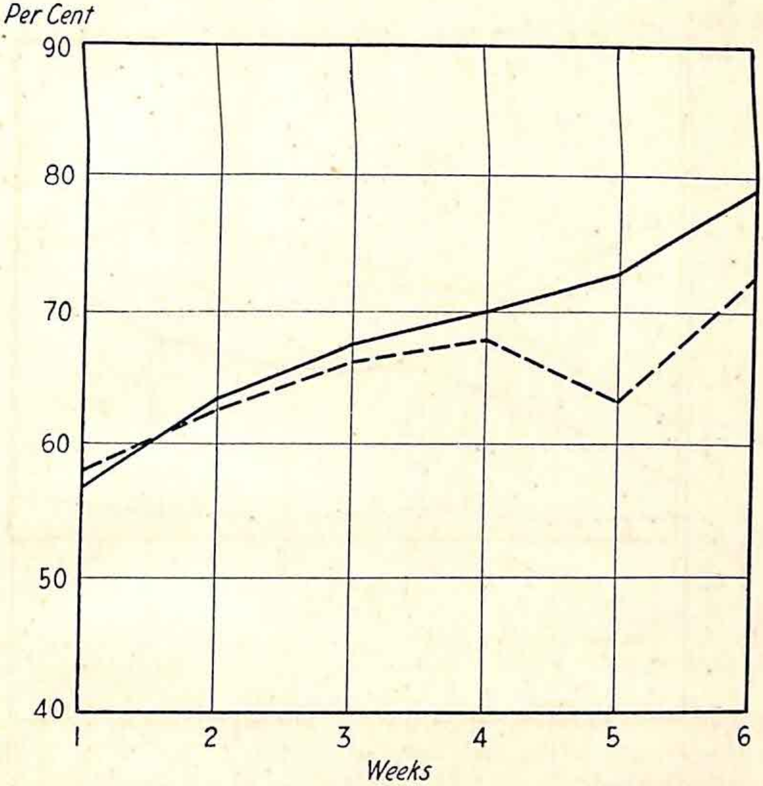

Figure 25. Relation of Regularity of Observations to Initial Progress in Gaining Bladder Control as Shown by Plus-Minus Ratio (Regular ——, Irregular — —)

average age in starting points. Infants with no previous training are among the younger of the subjects of this study. Infants who had been given no previous training were not started older than forty-four weeks.

Among the no previous training group, nine were male infants and three were female infants. The graphs for the two groups show the general nature of the gains through the first six weeks of training. The average gains made by the no previous training group were 32.9 on the plus-minus ratio and 17.2 on the plus-wet ratio. The corresponding gains for the previous training group were 10.91 and 6.58.

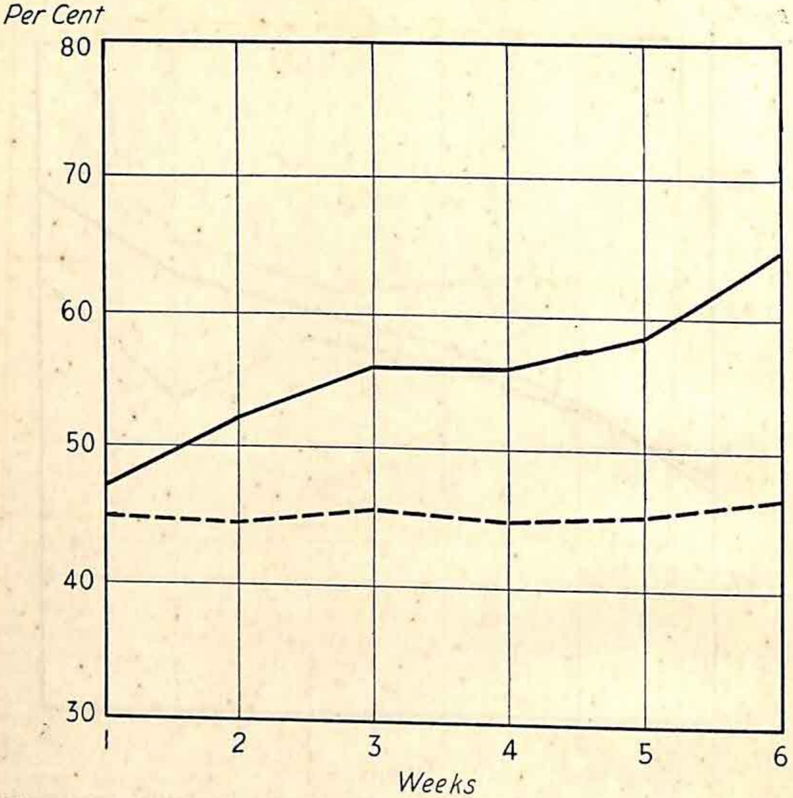

Figure 26. Relation of Regularity of Observations to Initial Progress in Gaining Bladder Control as Shown by Plus-Wet Ratio (Regular ——, Irregular — —)

Relation of No Previous Training to Age

A further analysis of the data on the no previous training group was made to determine the relation to age. An examination of the data indicates that the younger group of five infants, whose average age was 21.6 weeks, conditioned more readily to the use of the chamber for voidings in the early weeks than the older group of infants, whose average age was 38.0 weeks. The starting points for the two age levels were 52.4 for the former and 17.5 for the latter. The significance of the differences in starting levels was found to be much less than .01 on the plus-minus ratio and more than .02 on the plus-wet ratio.

During the initial period the average gain made by the younger group with no previous training is 13.46 in the plus-minus ratio.

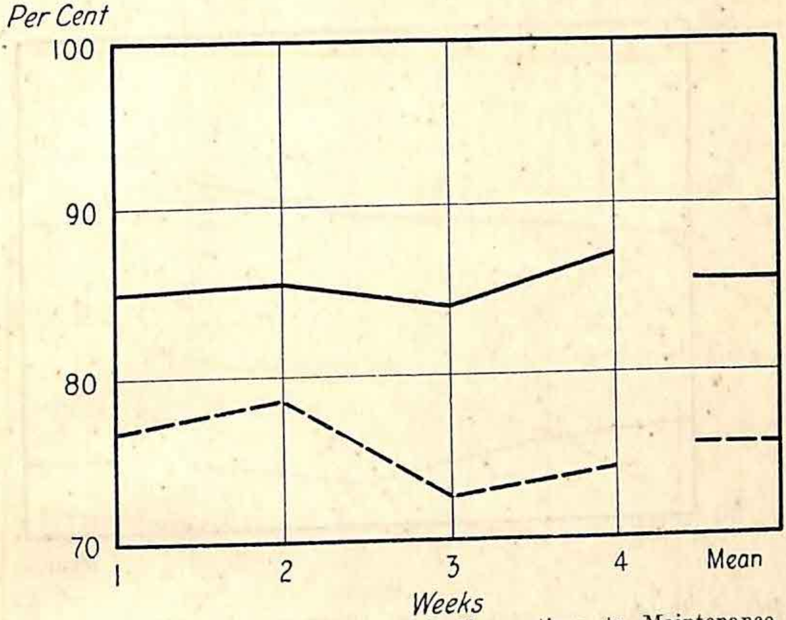

Figure 27. Relation of Regularity of Observations to Maintenance of Bladder Control as Shown by Plus-Minus Ratio (Regular ——, Irregular — —)

The P value is less than .10. The average gain by the older group on this ratio is 46.93, the P value being much less than .01. On the plus-wet ratio the gain by younger group is 6.68, P being .60. For the older group on this ratio it is 27.56, the P value being .02. Thus on the plus-wet ratio the younger group with no previous training made only a slight gain, whereas the older group made a large gain which has high significance.

Relation of Rating on Infant Tests to Bladder Control

Initial Progress

In Chapter II of this study a brief description was given of the psychological test which was administered to all infants of the directed group. Among these infants thirteen were rated as "average" and twenty-two as "above average" as judged by tentative norms available at the Iowa Child Welfare Research Station. The infants were grouped on the basis of these ratings. This classification resulted in two groups of infants with the same average

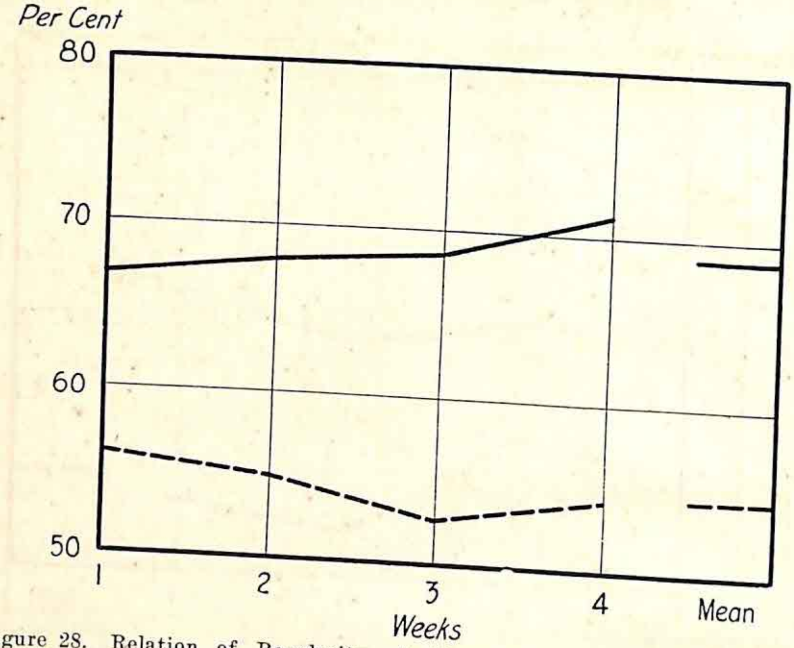

Figure 28. Relation of Regularity of Observations to Maintenance of Bladder Control as Shown by Plus-Wet Ratio (Regular ——, Irregular — —)

age and with about the same starting level. This latter fact can be seen on the graph (Figure 31). The average gain on the plus-minus ratio for the infants rated "average" is 23.02 with a P value of less than .01, and the average gain for the "above average" group is 16.55 with a P value of less than .01. The difference in gain is only 6.47 which was found to have no predictive value in favor of either group, the P value being more than .4.

RELATION OF FREQUENCY OF VOIDINGS TO AGE

At Four Age Levels

Frequency of voidings for infants on four age levels were compared for significant differences (Figure 32). The ages from the youngest to the oldest groups are 33.2, 46.1, 57.4, and 73.4 weeks respectively. Their corresponding mean frequency is 83.9, 79.7, 72.8, and 65.7. The average difference from one age level to the next in each case is small. However, the average difference from the youngest age level to the oldest age level is 16.49. The P value for this difference is .05 showing a significant difference in favor

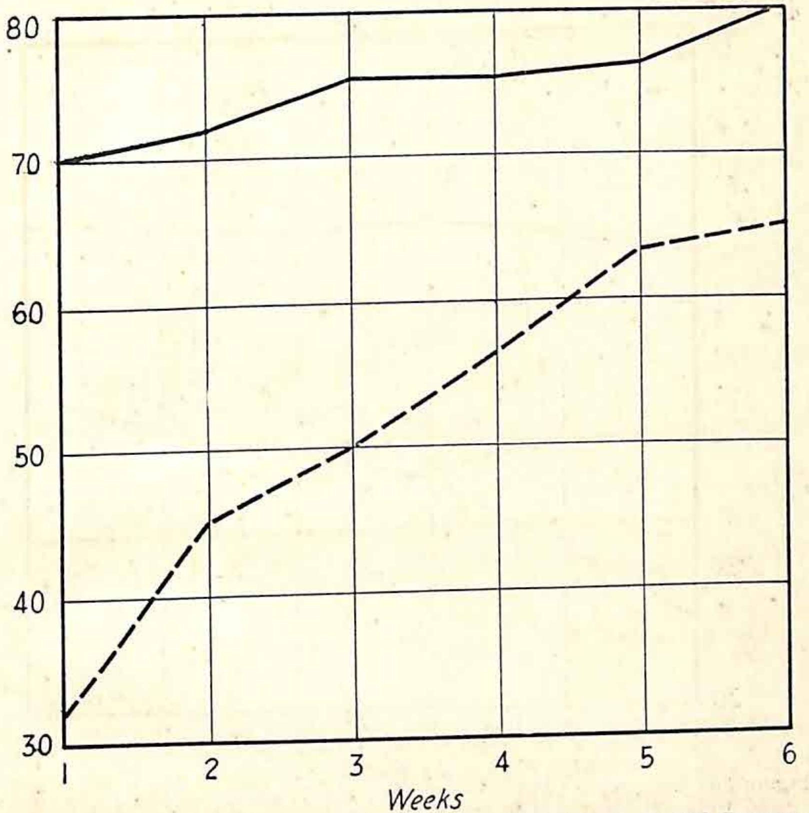

Figure 29. Relation of Amount of Previous Training to Initial Progress in Gaining Bladder Control as Shown by Plus-Minus Ratio (Previous Training ——, No Previous Training — —)

of fewer voidings at the older age level. It should be noted that a very great time unit (40.2 weeks) elapsed before a difference of any significance was shown.

At Two Age Levels in Same Infants

Frequency data for ten infants with an average age of 56.2 weeks were selected for comparison with data for the same infants at an age level of 71.7 weeks (Figure 33). This time interval is approximately four months. The average number of voidings at the younger age level is 82.4 as compared with 75.7 for the older age level. The average number of voidings at each age level is based on the total voidings on the chamber and in clothes over a period of four weeks for each infant. Accordingly, it can be seen that

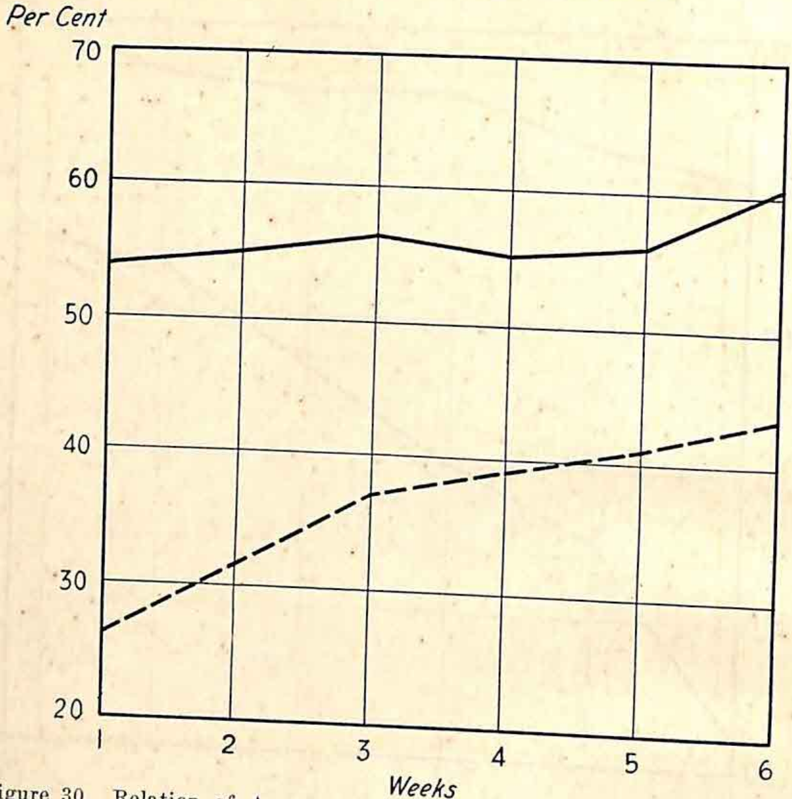

Figure 30. Relation of Amount of Previous Training to Initial Progress in Gaining Bladder Control as Shown by Plus-Wet Ratio (Previous Training ——, No Previous Training — —)

in the case of the same infants an interval of four months duration results in an average decrease of 6.7 voidings per week. The significance of this difference was found to be low, the P value being a little less than .2. Frequency does not significantly change over a relatively long period of time.

RELATION OF FREQUENCY OF VOIDINGS TO SEX

Boys void more frequently than girls as indicated by Figure 34. The mean frequency for boys is 83.8 voidings per week as compared with 75.6 voidings per week for girls. Greater variation in frequency of voiding will be noted for boys than for girls. This variation is measured by the standard deviation values for each group. For boys the standard deviation value is 28.2, while for girls it is 10.0. This difference has practically no predictive value

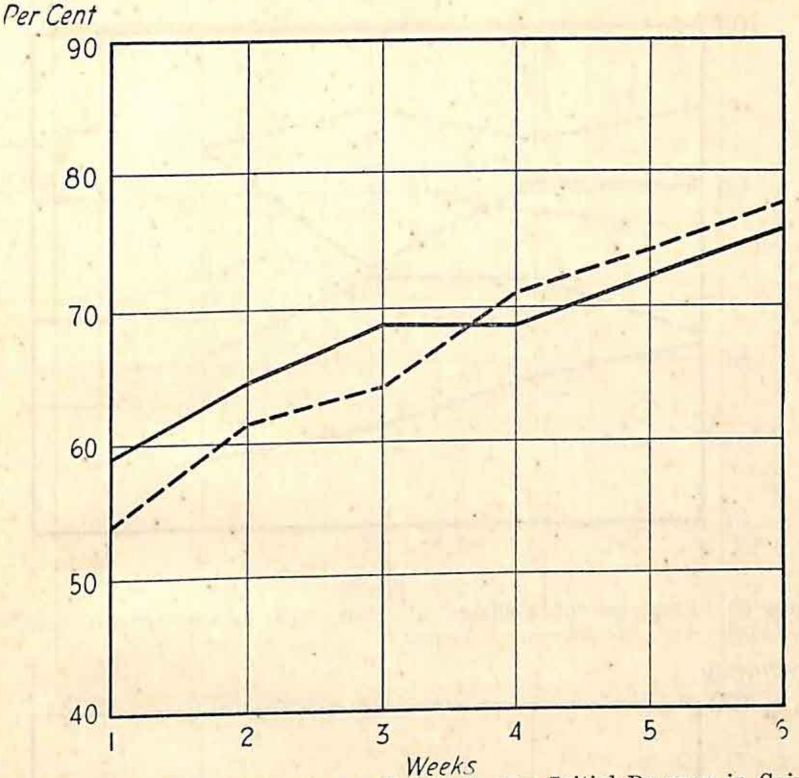

Figure 31. Relation of Rating on Infant Test to Initial Progress in Gaining Bladder Control as Shown by Plus-Minus Ratio (Above Average ——, Average — —)

as measured by the fifth formula given in the tabulation on page 25. The P value is a little less than .40.

Relation of Child Initiative to Maintenance of Bladder Control

Child initiative in this study refers to the child's ability to assume responsibility for his bladder routine by warning the mother that he needs to use the toilet. These warnings are in the nature of gestures or words.

The subjects for which warnings were recorded were compared with subjects for which no warnings were reported on the maintenance phase of control. The average ages for the two groups are approximately the same, 55.8 and 54.5 weeks. By the use of both

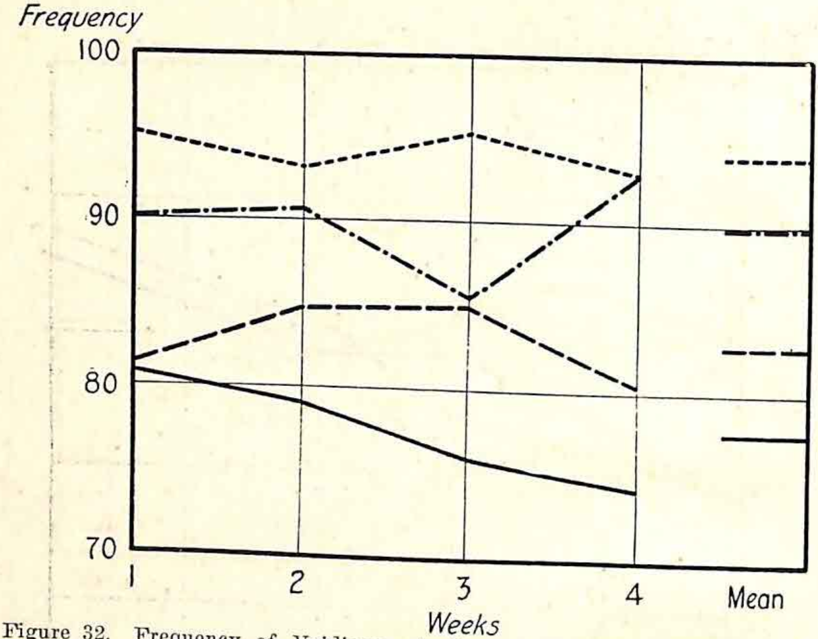

Figure 32. Frequency of Voidings at Four Age Levels (Oldest ——, Third — —, Second —·—, Youngest ....)

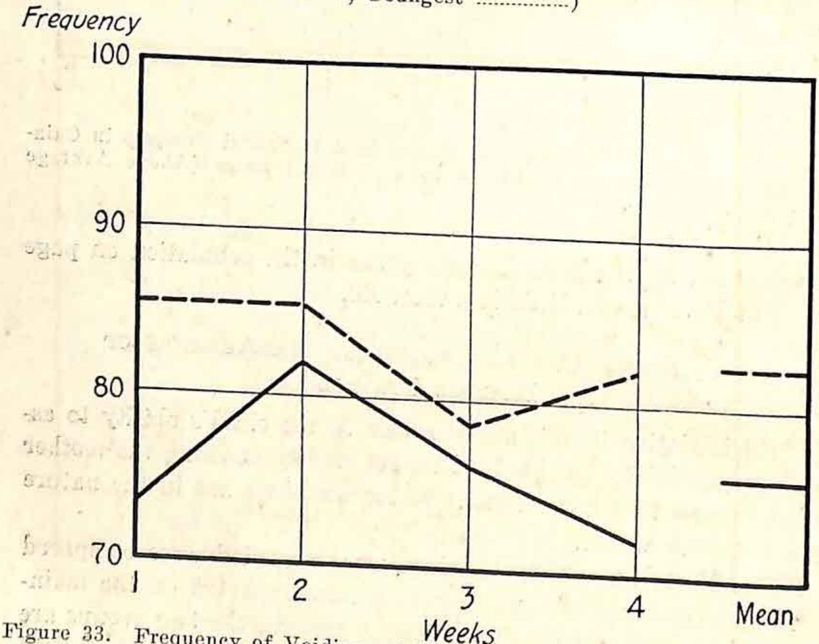

Figure 33. Frequency of Voidings at Two Age Levels in the Same Infants (Older ——, Younger — —)

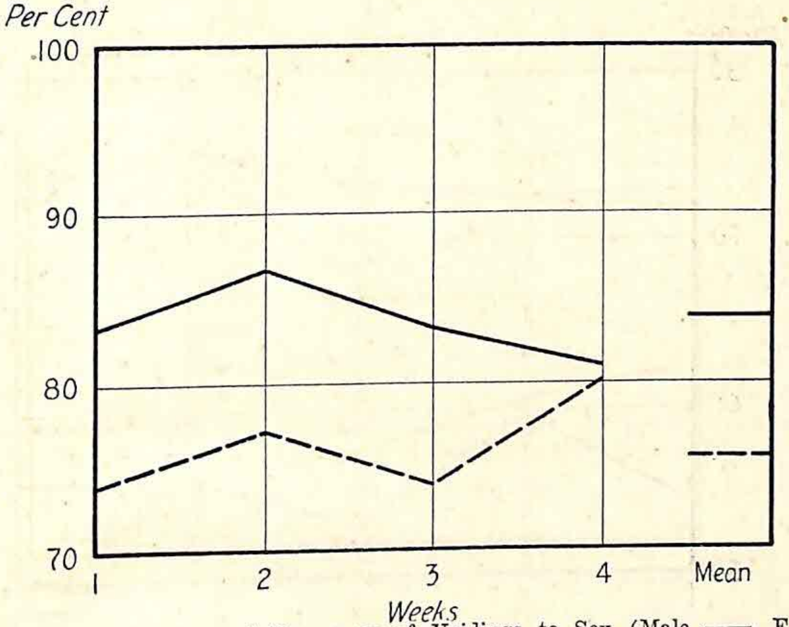

Figure 34. Relation of Frequency of Voidings to Sex (Male ——, Female — —)

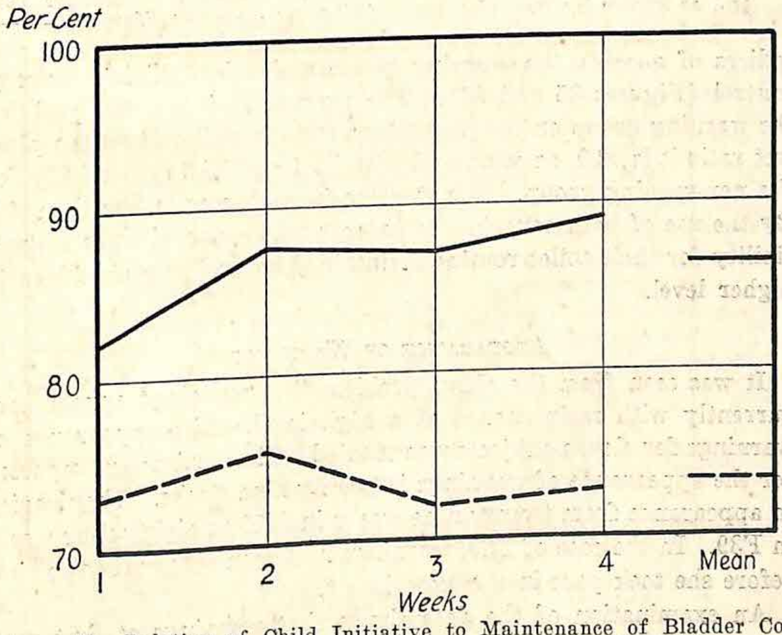

Figure 35. Relation of Child Initiative to Maintenance of Bladder Control as Shown by Plus-Minus Ratio (Warning ——, No Warning — —)

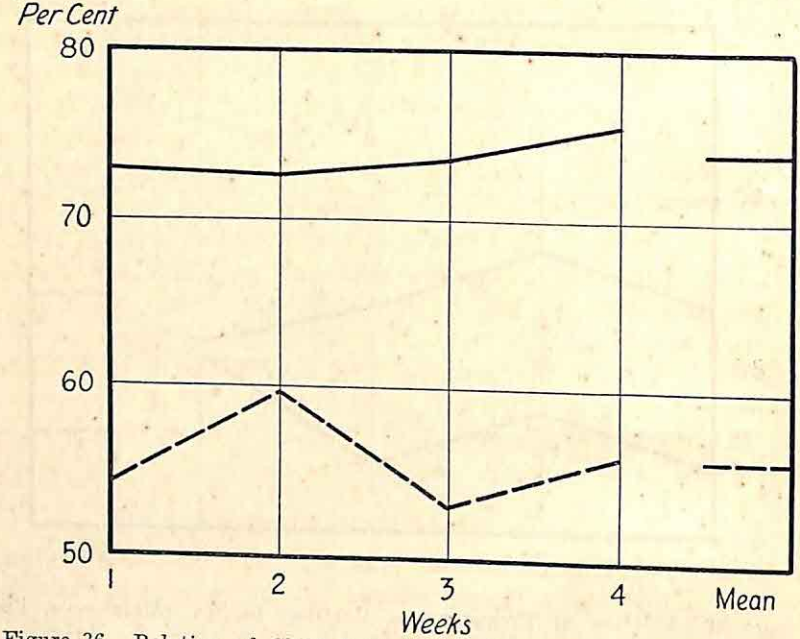

Figure 36. Relation of Child Initiative to Maintenance of Bladder Control as Shown by Plus-Wet Ratio (Warning ——, No Warning — —)

indices of success, the warning group maintained higher average control (Figures 35 and 36). The average maintenance level for the warning group on the plus-minus ratio is 86.4 and on the plus-wet ratio it is 73.9, as compared with 73.3 and 55.8 respectively for the nonwarning group. The P value in each case is less than .01. By the use of both criteria, the infants who assumed some responsibility for their toilet routine maintained control at a significantly higher level.

Appearance of Warnings

It was seen from the above problem that warnings appear concurrently with maintenance at a high level. The appearance of warnings for eleven subjects was studied. The earliest age reported for the appearance of warnings is twenty-nine weeks. They varied in appearance from twenty-nine weeks in M10 to eighty-four weeks in F39. In the case of F39, warnings had been observed some time before she took part in the experiment.

An examination of the data shows that warnings at first were infrequent. The greatest number reported for the eleven subjects for the first week of observation is eight. In general, warnings followed by success increase rapidly over warnings followed by failure or accident. For the younger infants the ratio of warnings was low and sometimes dropped out altogether. In the cases of M13, F33, and F35 they dropped out completely after having been present for several weeks. For older infants, as M21, F6, F34, and M36, the nature of warnings reported were usually in the form of gestures, i.e., the child makes a movement to the toilet room, evidences distress, or whimpers. M15, F33, and M36 made movements in the direction of the toilet before they were able to give vocalized warnings. M21 and M36 gave warnings during the night before giving them during the day; the warnings in these cases were in the form of crying and whimpering. A graphic presentation showing the appearance of warnings in relation to the level of control will be shown in the following section on typical cases.

CASE STUDIES OF EIGHT SUBJECTS[1]

The purpose of the following section is to illustrate the operation of some of the factors treated statistically in the previous section as they occur in individual infants.

M10 illustrates the progress of an infant of twenty-three weeks who has had previous training. For a period of five weeks the mother, a graduate nurse, recorded systematically all observations. At the sixth week she provided an improved nursery chair with the result that she could care for the child more conveniently. The curve at the sixth week, after training began, accordingly shows a rise on both ratios. Warnings appeared during the seventh week.

M13 is an only child, twenty-eight weeks of age. The mother, a college graduate, reported previous training for bowel control but none for bladder control. The high starting point probably means that the mother inadvertently did train for bladder control. Control as indicated by the two criteria was maintained on a high level until the child was thirty-eight weeks old. At this point an interference factor, intestinal influenza and head cold, resulted in a drop in the maintenance level, and also added to the difficulty of systematic recording. Moreover warnings, which had appeared during the thirty-third week and continued on the high maintenance level, dropped out gradually following the thirty-eighth week.

M15, an only child, was thirty weeks of age when records were first taken. The mother, a college graduate, had given previous training with some success. The infant reached a plateau during the fourth week and thereafter maintained a high level of control on both ratios. The home exhibited few interference factors. Warnings appeared when the child was forty weeks old and continued throughout the observation period.

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[1] Case histories on all the subjects in the directed group are given in the Appendix of the manuscript copy of this study on file at the State University of Iowa Library, Iowa City, Iowa.

F20, thirty-seven weeks of age at the beginning of observation and the third child, had received previous training with responsibility divided between mother and maid. Training conditions for this child included numerous interference factors and irregular home routine regarding eating and sleeping. The mother, a college graduate, kept unsystematic records of observations. The failure in the first weeks by the mother to record the wets resulted in a decrease of the plus-wet ratio. It was pointed out on page 22 that failure to systematically record all observations affects the plus-wet ratio. This case illustrates the drop in the record following short breaks. No warnings were given by this subject up to the sixty-sixth week.

M27, an only child, forty-four weeks of age, had received no previous training. This case was conditioned to the chamber with difficulty in spite of the mother's systematic efforts. Results show that observations were systematic throughout the training period, that after the third week the failures and wets decreased materially, and that a plateau was reached at the sixth week. Warnings did not appear.

F34, the second child, was fifty-three weeks of age at the beginning of the observation period. Previous systematic training had been given with satisfactory results. Physical home conditions were favorable to training. Recorded warnings appeared in the fifty-third week, although the mother reported their use by the subject for two weeks previous to this time.

F35, the second child, fifty-nine weeks of age, had previous training with little success reported. Many temporary and permanent interference factors affected the child—the toilet was on the second floor, the child offered resistance to systematic routine, and the mother was inconsistent in her control of the child. These conditions showed improvement about the sixty-seventh week. Warnings appeared in the sixty-eighth week and dropped out. They reappeared in the seventy-first week and made successive increases thereafter.

F6 was an only child, seventy-five weeks of age. The parents, both college graduates, had trained the child previous to the observation period. Successive gains are shown during the first three weeks. Teething occurred during the fourth week and the curves show a drop during this week from the level of the third week and also show a gain during the fifth and sixth weeks. The principle established by the statistical treatment of long breaks, that control goes on again following a break at about the level preceding the long break, is illustrated by this case. Warnings appeared in the seventy-ninth week. When training was resumed in the ninety-second week, the warning ratio was likewise on a higher level.

SUMMARY OF GAINS AND DIFFERENCES

The gains and differences in gains on the initial period, the differences in levels of control on the maintenance period, and the differences in frequency by groups and from group to group have been summarized in Tables 1 and 2. For each of these gains and

Table 1

Summary of Gains and Differences of Gains Made by Groups on Initial Period

Group	Ratio	Gain	Standard Deviation of Gain	Statistical Difference Between Means			Gain Favoring	Differ-ence	Statistical Difference Between Means		
				t	n	P			t	n	P
Younger	+ —	+14.81	18.7	2.628	11	.02	Younger over older	3.01	.351	22	.70
Middle	+ —	+28.17	23.2	4.028	11	.01	Middle over older	16.37	1.721	22	.10
Older	+ —	+11.80	21.5	1.836	11	.10	Middle over younger	13.36	1.488	22	.20
Younger	+ Wet	+ 6.96	19.1	1.204	11	.20	Middle over older	3.43	.401	20	.70
Middle	+ Wet	+13.07	21.9	1.788	9	.10	Middle over younger	6.11	.668	20	.50
Older	+ Wet	+ 9.64	16.3	1.962	11	.05	Older over younger	2.68	.355	22	.70
Few interference factors	+ —	+25.90	19.8	5.383	17	.01	Few interference factors	15.28	2.140	34	.05
Many interference factors	+ —	+10.62	21.8	2.001	17	.05					
Few interference factors	+ Wet	+21.86	12.5	6.778	15	.01	Few interference factors	22.96	4.202	32	.01
Many interference factors	+ Wet	— 1.10	14.6	.256	17	.80					
Males	+ —	+21.62	27.2	3.562	20	.01	Males	8.06	1.056	34	.30
Females	+ —	+13.56	11.3	4.485	14	.01					
Males	+ Wet	+12.70	22.1	2.501	19	.02	Males	7.27	Insignificant		
Females	+ Wet	+ 5.43	13.0	1.565	13	.10					
Males (Equated)	+ —	+13.96	20.7	2.236	11	.05	Males	.01	Insignificant		
Females (Equated)	+ —	+13.95	11.6	3.989	11	.01					

Table 1 (Continued)
Summary of Gains and Differences of Gains Made by Groups on Initial Period

Group	Ratio	Gain	Standard Deviation of Gain	Statistical Difference Between Means			Gain Favoring	Difference	Statistical Difference Between Means		
				t	n	P			t	n	P
Males (Equated)	+ Wet	+ 9.17	18.9	1.602	10	.10					
Females (Equated)	+ Wet	+ 8.29	11.6	2.256	10	.05	Males	.88	Insignificant		
Only children	+ —	+17.67	23.7	3.071	17	.01					
Children with siblings	+ —	+18.86	20.9	3.719	17	.01	Children with siblings	1.19	Insignificant		
Only children	+ Wet	+15.06	19.5	3.193	17	.01					
Children with siblings	+ Wet	+ 3.68	17.1	.836	15	.40	Only children	11.38	1.743	32	.10
Regular	+ —	+22.06	20.4	4.602	18	.01	Regular	8.05	1.069	34	.30
Less regular	+ —	+14.01	23.7	2.366	16	.02					
Regular	+ Wet	+17.71	14.8	4.800	16	.01	Regular	16.01	2.597	32	.02
Less regular	+ Wet	+ 1.70	19.9	.342	16	.70					
No previous training	+ —	+32.98	22.9	4.775	11	.01					
With previous training	+ —	+10.91	18.0	2.905	23	.01	No previous training	22.50	3.121	34	.01
No previous training	+ Wet	+17.21	21.2	2.439	9	.05					
With previous training	+ Wet	+ 6.58	17.5	1.811	23	.10	No previous training	10.63	1.473	32	.10

Youngest with no previous training	+	—	+13.46	10.2	2.645	4	.05	Oldest with no previous training	33.47	3.289	10	.01
Oldest with no previous training	+	—	+46.93	18.9	6.096	6	.01					
Youngest with no previous training	+	Wet	+ 6.68	20.9	.642	4	.60	Oldest with no previous training	20.88	1.594	8	.20
Oldest with no previous training	+	Wet	+27.56	15.8	3.488	4	.02					
Average	+	—	+23.02	18.7	4.284	12	.01					
Above average	+	—	+16.55	24.4	3.181	21	.01	Average group	6.47	.815	33	.40

Table 2
Summary of Differences In Maintenance of Control
and In Frequency

Difference Favoring	Ratio	Difference	Statistical Difference Between Means		
			t	n	P
Maintenance of Control					
Same infants at older age	+ —	9.14	3.463	9	.01
Same infants at older age	+ Wet	9.89	3.547	9	.01
Fourth over first	+ —	9.81	1.715	18	.10
Fourth over first	+ Wet	18.07	2.907	18	.01
Second over first	+ Wet	1.48	.297	20	.80
Third over second	+ Wet	5.46	1.166	18	.30
Fourth over third	+ Wet	11.13	1.843	16	.10
Few interference factors	+ —	10.98	2.814	22	.01
Few interference factors	+ Wet	16.94	5.043	22	.01
Week previous to tooth eruption	+ —	8.13	3.771	11	.01
Week following tooth eruption	+ —	5.62	2.798	11	.02
Week previous to tooth eruption	+ Wet	7.10	4.524	11	.01
Week following tooth eruption	+ Wet	7.66	4.065	11	.01
Week previous to short break	+ —	.30	Insignificant		
Week previous to short break	+ Wet	1.70	Insignificant		
Week following long break	+ —	1.30	Insignificant		
Week following long break	+ Wet	1.90	Insignificant		
Females over males (Equated)	+ —	1.05	Insignificant		
Females over males (Equated)	+ Wet	6.70	1.489	21	.20
Only child over two or more	+ —	7.77	1.766	23	.10
Only child over two or more	+ Wet	6.15	1.106	23	.30
Regular over less regular	+ —	10.01	2.307	22	.02
Regular over less regular	+ Wet	14.45	3.268	22	.01

Table 2 (Continued)
Summary of Differences In Maintenance of Control and In Frequency

Difference Favoring	Ratio	Difference	Statistical Difference Between Means		
			t	n	P
Maintenance of Control					
Higher starting point for previous training group	+ —	38.09	6.160	34	.01
Higher starting point for previous training group	+ Wet	27.65	4.404	32	.01
Higher starting point for youngest, no previous training	+ —	34.85	4.414	10	.01
Higher starting point for youngest, no previous training	+ Wet	30.70	2.870	8	.02
Warning over no warning group (Equated)	+ —	13.14	3.911	17	.01
Warning over no warning group (Equated)	+ Wet	18.10	5.640	17	.01
Differences in Frequency					
First over third in same infants (Placements)		4.23	1.276	9	.20
First over third in same infants		6.71	1.452	9	.20
First age group over fourth		16.49	2.116	18	.05
Males over females (Equated)		8.24	.907	21	.40
Lower over higher temperature		2.40	3.213	4	.02

differences is included a statement of the statistical significance and the chances in 100 that the results were obtained by chance

THE QUESTIONNAIRE GROUP

The data from the questionnaire used in this investigation were arranged into four sections. These sections are: (1) the time at which control of the bowel and bladder functions was considered reliable by parents, (2) the time at which training was begun for bowel and bladder control, (3) the factors which interfered most with training, and (4) the methods and devices used in training for control of the two functions.

The age that children are considered reliable by parents for bowel and bladder control varies greatly as indicated in the following tabulation:

Age, Months	Per Cent Bladder Boys	Per Cent Bladder Girls	Per Cent Bowel Boys	Per Cent Bowel Girls
0 to 8	00.0	00.0	10.4	14.3
9 to 14	4.8	43.9	31.2	51.2
15 to 20	45.2	34.2	39.8	22.5
21 to 26	40.5	17.1	16.6	6.1
27 and older	9.5	4.8	2.0	6.1

The responses from the questionnaire indicate that boys are started later than girls in training for the control of bowel and bladder. The median starting age for bowel training is six months. For bladder control a greater difference in starting age is reported, the median age for boys being twelve months as contrasted with nine months for girls.

Excretory Function	Children	Median Age, Months	Range, Months
	Time Training Began		
	Boys		
Bowel	71	7	3 to 24
Bladder	65	12	3 to 24
	Girls		
Bowel	61	6	1 to 24
Bladder	56	9	1 to 24
	Time of Reliability in Bowel and Bladder Control		
	Boys		
Bowel	41	16	6 to 30
Bladder	42	21	12 to 30
	Girls		
Bowel	49	12	6 to 30
Bladder	42	16	9 to 35

These results are essentially in agreement with those reported by the Committee on the Infant and Preschool Child (49) of the White House Conference—somewhat earlier control for girls than boys. Both sets of data likewise show few children beyond two years of age who have not established both bowel and bladder control.

In reply to the question as to the conditions interfering most with training for bowel and bladder control, twenty-three mothers stated illness, teething, and colds as interfering most; nineteen reported irregular routine in feeding and sleeping; sixteen reported desire of the child to engage in play and outdoor activities; twelve stated the child's lack of comprehension and immaturity; twelve gave lack of time on the mother's part; ten stated absence from home, trips, and presence of guests; six reported neglect of training; five gave nervousness and restlessness; three reported resistance; one gave drinking too much milk; and one gave wearing diapers as interfering most with training.

The methods and devices reported as being used by mothers in training for control are given in the following tabulation:

Method or Device	Bowel Training	Bladder Training
Regular intervals	88	83
Before and after meals and naps	25	15
Soap stick, enemas, pressure	24	
Use of training word	9	7
Praise and rewards	8	9
Punishment, shame, scoldings, etc.	6	11
Give food, drink, or toy while on	4	10
Irregular intervals	3	10
Appeals to reason, or coaxes	3	4
Anticipates accidents	2	2

The results from the questionnaire are valuable in pointing out the wide variation in home practices relative to these four problems. The delayed training in the case of the boys may well account for much of the superiority of the girls in gaining ultimate control. The greater superiority of girls over boys in gaining bowel control is not as apparent as in the case of bladder control. In the latter

Age, Months	Weeks 1	2	3	4	5	6	Mean
	Frequency of Voiding						
6	11.7	16.7	11.3				13.2
9	15.7	14.7	14.0	9.7	9.0	13.7	12.8
12	10.0	13.0	8.0	11.3			10.6
15	14.3	10.7	9.0	12.0	11.0	14.3	11.8
18	10.0	11.3	7.7	8.3			9.3
21	8.7	9.7	6.7				8.4
24	13.3	8.0					10.6
27	6.7	7.0	5.7	8.0			6.9

case, girls were started at a median age of nine months while boys were started at twelve months.

THE UNDIRECTED GROUP

The records on the undirected group of thirty-two infants contributed findings on two aspects of bladder functioning—the frequency of voidings at age levels ranging from six to twenty-seven months, and the degree of control of infants on the plus-wet ratio under ordinary home practices.

An examination of the above tabulation shows successive decreases in frequency of voidings for each older age group. The data also show that this decrement is a slow process from one age level to another. Upon combining the results of the sixth and ninth levels, the twelfth and fifteenth, etc., thereby making four age categories, the following averages are obtained progressing from youngest to oldest age groups: 12.7, 11.4, 8.9, and 8.1.

The following tabulation, giving data on the degree of control as measured by the plus-wet ratio, shows increasingly higher levels of control at each older age level:

Age,	Weeks						
Months	1	2	3	4	5	6	Mean
			Frequency of Voiding Plus-Wet Ratio				
6	00.0	00.0	32.0				10.7
9	57.4	45.5	61.9	00.0	11.1	41.5	36.2
12	23.3	25.6	13.0	29.4			22.8
15	51.2	18.6	59.3	52.8	54.5	69.8	51.0
18	70.8	60.0	52.9	69.5			63.3
21	68.0	52.9	95.2				60.5
24	76.3	66.7					71.5
27	100.0	95.2	100.0	91.7			96.7
			Plus-Minus Ratio				
9	60.0	77.3					68.6
12	62.5	55.6					58.5
15	88.0	50.0	63.3	78.3			69.9
18	62.1	94.1					78.1
21	70.8	78.2					74.5

This rise in the curve of control on the plus-wet ratio proceeds from 10.7 per cent at six months to 96.7 per cent control at twenty-seven months. Two of the four cases at the older age had 100 per cent control. Two of the three cases at the six months level had been given no training, while but one case at the nine months level had had no training.

On the plus-minus ratio too few cases make any conclusion questionable, but the tendency toward learning to relax the sphincter musculature before learning to inhibit it is shown. This tendency is pertinent in view of a similar condition exhibited by the infants in the directed group.

THE LABORATORY GROUP

The results from the systematic observations on the seventeen laboratory infants contribute evidence to three problems: (1) the relation of age to frequency of voiding, (2) relation of sleep to bladder activity, and (3) the relation of temperature changes to bladder activity.

The observational periods on these infants were of eight and one-half hours duration. Frequency by age levels has been arranged in the following tabulation:

Age, Months				Weeks				
	1	2	3	4	5	6	7	Mean
			Frequency of Voiding					
2	10.0	11.0	7.5	8.3				9.2
3	6.0	9.0	8.0					7.7
4	12.5	12.5	10.0					11.7
5	8.0	12.0	5.0					8.3
6	8.0	11.0	15.0					11.4
7	9.0	16.0	12.0	8.0	12.0	8.3		10.9
8	7.0	10.0	10.0	10.0	14.0	8.0	12.0	10.1
9	14.0	9.0	12.0					11.7
10	16.0	8.0	8.0					10.5
12	11.3							11.3

The data here are more suggestive than conclusive due to the limited number of infants observed. They do show, however, that in the age range of from two to twelve months, there are no observable changes in frequency from age level to age level. The individual variations within each age group are in some instances greater than the change from age group to age group.

It was possible during the observation period to check the relation of voidings to naps. A total of 126 naps were observed among seventeen infants; the length of nap averaged 61 minutes and varied from 15 to 170 minutes. In 119 of these naps, the infants remained dry and voided only after they were fully awakened.

The voidings usually occurred a few minutes following the waking period. In some cases this interval was fifteen minutes. In five naps sleep was momentarily broken, following which voidings occurred and the infant again resumed sleep. In only two instances was an infant found wet while actually sleeping. Because of the observations being made at approximately five minute intervals, it is possible that these two infants could have been momentarily aroused and voided without the knowledge of the observer.

It has long been known that the bladder function is related to temperature changes. In general, this relationship is an inverse one, i.e., with increases in temperature decreases in frequency of voidings occur. It was possible to observe the effects of a change in mean temperature from 84.6 to 76.2 degrees in the case of five infants, with intake of fluids, period of observation, and daily routine held constant. The observations were made on June 4 and 5 respectively. The total voidings for the five infants were forty-nine for the first day and sixty-one for the second day. By the use of the fourth formula given in the tabulation on page 25 the significance of this difference in the two sets of data was calculated. The P value derived is .02. The reason for reduced frequency with higher temperature is probably the increased elimination through the skin.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The general aim of this study was to investigate the psychological factors affecting the establishment of bladder control in infants and young children.

The sources of data which contributed findings on this problem were: (1) a questionnaire group of 172 infants and young children; (2) an undirected group of thirty-two infants; (3) a laboratory group of seventeen male infants; (4) a preliminary training group of six infants; and (5) a main training group of thirty-six infants. The important findings were made by the training group of thirty-six infants. The findings from the other groups were used to supplement and corroborate those of the main training group. An analysis of these data was made by the statistical and case method procedures. When possible a graphic presentation of results was made.

Throughout this study bladder control has been defined as the ability of the child to void when placed on the chamber and the ability to retain the urine during the interval. The criterion used to determine success on the first ability was the plus-minus ratio or the ratio between successes and failures on the toilet, and the criterion on the second was the plus-wet ratio or the ratio between successes on the toilet and voidings in clothes. Evidence from the training and undirected groups of infants indicated that the former is a measure of a more immature or elementary process, while the latter criterion measures a more advanced process in bladder control.

Systematic training results in an initial period of rapid progress and a later period of slight progress. For the training group of thirty-six infants the initial period was six weeks. The initial period was defined as the period during which significant weekly gains were made, and the maintenance period as the following period during which slight but insignificant gains were made.

Infants respond to systematic training at all age levels as measured by both criteria of progress. Among three age groups averaging 25.3, 42.2, and 62.5 weeks, no child made a significantly higher gain over the others on either ratio. With each older age level among four age groups, maintenance of control was found at higher levels. The differences were not significant from one age level to the following, but the difference in maintenance level between the youngest group of 32.9 weeks and the oldest group of 76.7 weeks was significant. An interval of four months in the maintenance of control in the case of the same infants resulted in a significant difference in maintenance in favor of the older age level. The cost of maintenance indicated a trend in favor of the older age.

Two types of interference factors were recognized in this study. Factors, whose effects are operative over a long period, were called permanent interferences and were held to be responsible for plateaus in the progress of control. Factors whose effects were of short duration were called temporary interferences. These latter interferences account for the short fluctuations in the curve of learning.

Subjects with few permanent interferences in the home situation made highly significant gains on both ratios. Subjects with many such interferences made only slightly significant gains on the plus-minus ratio, while on the plus-wet ratio they remained on a plateau. The difference in gain in favor of the former group was found to be significant. Few interferences resulted in higher maintenance of control as judged by the two criteria.

Teething, a temporary interference factor, definitely altered the level of control. A significant loss occurred during the week of eruption and a significant gain was made following the week of eruption. Breaks or gaps in recording observations were found to have little effect on the maintenance level of control. Short breaks resulted in a slight decrease in level of control over the week previous to the break, while long breaks resulted in a slight increase in the level of control.

No sex differences were found on either the initial or maintenance phases when age and starting point were held constant. Both sexes made significant gains on each ratio. Boys were found to be more variable as measured by their standard deviations.

By the use of both criteria of success, the only child showed progress equal to or superior to that of infants with siblings. This was found to be true for both the initial and maintenance periods. The differences noted were not held to be due to the "only" factor, but rather to the factors characteristic of the homes represented by the two different groups of infants.

Infants subjected to very regular training, as judged by the consistency of the records, made significant gains on both ratios. Infants subjected to less regular training made slightly significant progress on the plus-minus ratio and no gain on the plus-wet ratio. On each ratio the regular training group maintained control at a significantly higher level. Regularity is held to reflect the consistency and attitude of the mother in fulfilling her part of the training program. Infants with previous training were found to start significantly higher than those with no previous training. Both groups made significant gains over the initial period. Among the infants with no previous training the younger infants started significantly higher. The older infants with no previous training responded less readily to training in the early weeks of the initial period. Delayed training is held to account for this greater difficulty of conditioning to the use of the toilet. Little progress was made on the plus-wet ratio by the younger infants with no previous training. This finding is interpreted as further evidence that the plus-wet ratio measures a more mature process in the control of the bladder.

Infants rated as ''above average'' on a test of development made slightly smaller gain than did infants rated ''average'' with age and starting point controlled. The difference in gain had no significance.

A slight decrease in frequency was noted with each older age level. The difference in frequency from the youngest age group of 33.2 weeks to the oldest group of 73.4 weeks was found to be significant, but not from age group to age group. In the same infants at two age levels fewer voidings occurred at the older level. The difference in this case was very slight. It was found that, in the case of the same infants, an interval of four months resulted in an average decrease of 6.7 voidings per infant per week.

With age controlled boys voided somewhat more often than girls. The mean frequency for eleven boys was found to be 83.8 per week as compared with 75.6 for twelve girls. Greater variation in frequency of voiding was noted for boys. The difference in frequency in sexes had no significance.

Wide individual differences were found in frequency of voiding. M27 at forty-nine weeks of age voided an average of 180 times per week over a period of four weeks. M19 at forty-three weeks voided an average of 68.7 times per week for this same period. M27 twelve weeks later voided an average of 164 times per week, while M19 nineteen weeks later voided 71.7 times per week.

Frequency of voiding is inversely related to temperature. A difference in mean temperature of 8.4 degrees significantly altered the frequency of five subjects under controlled conditions.

The maintenance level of subjects assuming some responsibility was compared with that of subjects assuming no responsibility for their toilet routine. The average ages of the two groups were 55.8 and 54.5 weeks respectively. Infants giving warnings were found to maintain control at a significantly higher level on both ratios.

Data from the questionnaire and the training groups indicated that boys were started later than girls in training for bladder control. This fact, together with that of greater difficulty of catching urine during training in the case of boys, is held to account in part for the greater prevalence of enuresis among the boys.

Data were presented which pointed out that few children beyond two years of age have failed to establish bladder control.

A total of 126 naps and their relation to voiding were observed in the case of seventeen laboratory infants. The infants remained dry throughout 119 of these naps and only voided after they were fully awakened. In the remaining naps the infants momentarily awakened and voided or voided while asleep.

CONCLUSIONS

The following conclusions are presented:

1. Systematic observations in the home are practicable.
2. Bladder control under the conditions of the home may be successfully investigated.
3. The ratio of successes to failures on the toilet and the ratio of successes on the toilet to "accidents" are satisfactory criteria for estimating progress in bladder control.
4. A time unit of seven days is a satisfactory one for following progress in bladder control.
5. Progress in bladder control may be thought of in terms of an initial and a maintenance period of progress.
6. Bladder control should be viewed in terms of degree of control.

7. Significant gains can be made in bladder control at all age levels above the third month.

8. Older infants maintain control at a higher level with slightly less expenditure of effort on the part of the mother.

9. Interference factors may be classified as permanent and temporary for purposes of analyzing their effects.

10. The presence of interference factors materially reduces the possibilities of making progress in a training program for bladder control.

11. The toilet situation should be simple and free from complications for satisfactory progress in training for bladder control.

12. Portable nursery chairs and toilets facilitate training for bladder control in the early stages.

13. Nursery chairs or toilets with deflectors should be provided for boys.

14. Mothers with "only" infants are more successful in training their child for control than are mothers with two or more children.

15. Delayed training results in greater difficulty in conditioning to the toilet in the early period of training.

16. Voidings occur following rather than during naps.

17. Child initiative appears concurrently with maintenance of control at a high level.

18. Most children have established control by the time they reach the second year.

19. There is no superiority of sexes in gaining bladder control.

20. Under ordinary home practices training for boys starts later than for girls.

21. Decrease of frequency of voiding is a slow process.

22. With increase in age a slight decrease in frequency occurs.

23. Boys void somewhat oftener than girls.

24. Greater variation in control and in frequency occurs in boys.

25. Wide individual difference was found in frequency of voiding.

26. Frequency of voiding decreases with an increase in temperature.

RECOMMENDATION FOR A PROGRAM FOR ESTABLISHING BLADDER CONTROL

The following recommendations are based on protocols, on case studies, and on the experimental findings of this investigation.

Training for bladder control may be begun as early as the third month with satisfactory results. Bowel control is more readily acquired and may precede training for bladder control.

Since infants left untrained after the seventh or eighth month are conditioned with difficulty to the use of the toilet, it is important that training be started during the first six months of life, even if such training cannot be conducted in a highly systematic manner. The frequency or periodicity of voiding may be determined by a preliminary observation period of a few days. Little change in frequency may be expected over a relatively long period. Periodicity of voidings is not highly regular, i.e., voiding may vary from a few minutes to over an hour in the same day.

The greatest economy in time and effort to the mother is secured by fitting the toilet program to the necessary home routine. Infants should be handled for their toilet routine at certain convenient periods such as, before and after meals, naps, bath, and trips from home. In the early stages of training it is especially important to select periods when the child may be expected to be successful, because at this time the voiding response is being conditioned to the contact stimulus of the chamber.

Infants usually sleep dry during their naps. It is, therefore, important that the infant be reached and placed on the chamber upon waking. A continuation of this practice results in the child retaining the urine until he is reached.

Toilet facilities on the second floor of the home involve greater care and effort in training. Portable nursery chairs or chambers are accordingly more satisfactory for training infants because of their convenience to the living quarters of the home. Small chambers are very satisfactory early in the training program if the infant must be supported by the mother. As soon as the infant can sit with support, a comfortable nursery chair with back support should be provided. A deflector type of nursery chair should be provided for boys in order to direct the urine into the chamber. A chamber suitable to the child should be selected and used consistently.

Little postural ability is needed by the child previous to starting a program for bladder control. A young infant can be conveniently held in the arms or the lap for necessary toilet routine.

Little is gained by keeping the infant on the toilet for an indefinite period. Infants trained to the use of the chamber respond almost immediately upon being seated, provided there is an accumulation in the bladder. A training word or expression which can easily be acquired by the child should be selected and consistently used throughout the training program. Placing the child on the chamber in excess of his regular periodicity results in failures and may develop resistance.

Training should be as free from interferences as possible. The training program should not be complicated by placing the child in a variety of toilet situations. Training should be resumed as early as possible following lapses due to illness, teething, and other interferences.

Food, toys, and playthings should not be given to the infant while on the toilet because the eliminative functions should become conditioned only to the chamber situation, which includes contact with chamber and sound of training word.

The earliest warnings appear in the form of fussing, whimpering, and crying. Later these are replaced by gestures and vocalized warnings. The appearance of warnings accompanies the maintenance of control on a high level. Warnings by night may precede warnings by day and are usually in the form of whimpering and crying. It follows that it is important for the establishment of control to heed such warnings.

Night training may be started by placing the child on the chamber two to three hours following bed time. Dry nights may be expected after night feedings have stopped. Here, as in the case of naps, the infant should be reached upon waking and placed on the chamber. Such a procedure gradually conditions the child to wait until he is reached.

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APPENDIX

CASE HISTORIES

In the following section a brief description of some of the cases used in the preliminary and main directed groups of the study is given covering items of information from the medical findings, the Station examinations, and the protocol of visits to the homes. These descriptions are classified under: (1) early development, (2) general health, (3) status of training at the time of the initial observations, (4) type of toilet used, (5) age training was initiated and duration of training, (6) home conditions, and (7) quality of record.

M1 The early development of the child was normal. His general health rated as good. Observations were first made when the child was forty-four weeks old, making M1 the youngest case in the preliminary group. The mother's first records were unsatisfactory and not included in those with the main experimental groups. Observations were resumed several months later at the time the child was sixty-two weeks of age. Data were secured over a period of nine weeks. Many interferences were present during the second observation period: the family moved from an apartment to a large house; a full time maid was employed; outside interest kept the mother away from home many afternoons. Routine of child was very irregular. The mother reported lack of time, laxness of maid, and resistance of child as responsible for irregular training and incomplete records. At eighteen months the child's control was not very satisfactory, and he was assuming no initiative for his control. In the new home situation toilet and bedrooms were on the second floor. The psychological rating for M1 on the infant test of the Iowa Child Welfare Research Station was ''average.''

M2 No medical examination was given because the child had been one of the cases in the preliminary group and had control fairly well established at the time the main experimental work was begun. M2 was first observed at sixty-one weeks of age. Incidental training had been given previously. Home conditions were quite favorable to training, although routine was somewhat irregular due to the mother's desire to keep the child outdoors, and also to the fact that the mother shared responsibility for routine with the maid. Continuous records were secured for a period of five weeks. Records were carefully and completely kept. Station infant test rating for M2 was ''above average.''

F3 This child was observed for a period of several weeks during preliminary work. At the time of observation F3 was fifty-four weeks of age. Previous training had been given. The coöperation of the mother was not satisfactory. Physical conditions of the home were favorable to training. The mother stated that lack of time and desire of child to be outdoors constituted the greatest difficulties to routine. The records secured for F3 were not used as data in this study due to incompleteness. No medical or psychological ratings were made.

M7 The early development of this child was regular and uneventful, his medical rating excellent. Training for bladder control began at twelve weeks of age. The child had had no previous training except for incidental bowel movements. The bathroom and sleeping quarters were located on the second floor of the home. Because of the age of the child, recording of all voidings was difficult. More complete records were secured near the end of the observation period. The family moved to a new home during the fifth week of training. Lack of time and location of toilet were the chief difficulties to regular routine for bladder training. The observation period extended over thirteen weeks. The infant test rating for M7 was "above average."

M9 The general health of M9 was excellent; no irregularities in birth and early history were recorded. Training began when the child was twenty weeks of age. No previous training had occurred except for the occasional use of chamber for bowel movements. Home conditions were very favorable to training. The mother was a graduate nurse and had ample time to care for the infant. The mother first used a small chamber, changing to a nursery chair in a few weeks. The routine was very regular. At six months of age the infant began to sleep dry through the night. Records indicated very systematic observations. Observation extended over a period of fifteen weeks. Rating on the infant test was "above average."

M10 The general health of M10 was excellent. Training for bladder control had been given previous to this study. First observations were made when the infant was twenty-three weeks of age. The mother reported that the infant had difficulty in changing from a reclining position in her lap to a sitting position on the toilet. Many interruptions were present during the initial weeks of training because of the mother's desire to keep the infant outdoors on fair days. A small toilet offered difficulties because of the large size of the infant. A change was made to a new nursery chair with a deflector during the sixth week of observation. The period from this point on was much more favorable to training. M10 was observed to sleep dry from 10 P.M. until morning at about seven months of age. The observation period lasted fourteen weeks. Record keeping was very complete; mother was formerly a graduate nurse in pediatrics. Rating on the infant test was "above average."

F14 The physical development of this child was excellent. No previous training had been given for either bowel or bladder control. Training began when F14 was twenty-nine weeks old. The mother had difficulty in conditioning the child for regular bowel evacuation. A brief period of illness of the mother and difficulty with enuresis in an older child interfered with the initial period of training. Sleeping quarters were on the second floor. A nursery chair was used in training. The data were secured over a period of twenty-nine weeks; only two short interruptions in record keeping were made.

The mother was much interested in the training program at all times. F10 had a number of head colds and cut several teeth during the period of observation. The infant test rating was ''above average.''

M16 The general health examination gave M16 an excellent rating; there was a history of eczema from birth. No training had been given previous to this study. Observations began at thirty weeks of age. The child did not condition readily to use of the toilet. Several weeks elapsed before more than chance successes occurred. The child at first trained on a nursery chair, but because of the difficulty of catching urine the mother began using a large toilet on second floor and a small chamber on the first floor. The mother insisted that this plan was more convenient, although it was probably unfavorable to progress in gaining control. Records were well kept despite the mother's apparent dislike for keeping them. The mother questioned the advisability of training at this age, thinking that washing diapers was easier. The period of observation continued for fourteen weeks. The infant test rating was ''above average.''

M22 The general health of this child was reported by the mother as being good. Medical examinations were not given because of the mother's unwillingness to coöperate. No previous training had been given. Training was begun on the thirty-ninth week. A modified toilet seat on the second floor was used for training. Much illness had occurred in the home through the winter and spring previous to the initial home interview. The mother had help in her home and preferred to spend her time outdoors in the garden or with the older children. The mother's interest in training was not great, but she agreed to make observations for a period of five or six weeks. Five weeks of uninterrupted data were secured. Rating on the psychological test was ''average.''

F23 The early development of F23 was normal, health rating excellent. Training began at thirty-nine weeks of age; no previous training had been given for either bowel or bladder control. A small chamber was used in training. The child responded readily to bowel control, but several weeks were needed to condition for voidings. Training continued over a period of twelve weeks. The home was located on the first floor and conditions were favorable to training. The mother was much interested in the training program. Home records were well kept. Rating on the infant test was ''average.''

F24 The early development for this child was uneventful. Her general physical condition was excellent. Only incidental training had been given the child at the time of initial interview. Training began at forty weeks and continued for thirteen weeks. The family moved during the third week of training, resulting in irregular routine and progress. A toilet seat was used in training. House guests and the responsibility for making plans to move to an eastern state interfered with progress. Record keeping was complete and well done. Rating on the infant test was ''average.''

F25 No medical record was secured because of the mother's absence from the city. The child was in good health at each home interview. Training for bladder control began at the age of six months. Observed training began at forty-two weeks and continued ten weeks. The mother had ample time for training the child. F25 first warned for voidings at night. Records were not complete and probably did not indicate all voidings made by the child. A small chamber was used for training in both living and sleeping quarters. The infant test rating was "average."

F28 The early development of F28 was irregular due to nutritional difficulties. The child's health at the time of the physical examination was excellent. Previous training had been given. Observations began when the child was forty-seven weeks of age. Home conditions were favorable to training, but the mother was frequently gone on visits to her mother in a nearby city. Observations were quite irregular and incomplete. A nursery chair was used in training. The infant test rating was "average."

F35 The early development of the child was regular, health excellent. The mother, much interested in the training program, was first seen in clinics. An older child in the home had been incontinent for several years. This older child did not improve during the period of observation of the younger child. Training began at fifty-nine weeks of age and continued for thirty weeks. At the time of initial observations the child was quite negative to toilet routine. Sleeping rooms and bath were on the second floor. Much confusion existed in the home relative to the toilet routine. F35 was permitted on the second floor only for sleeping and toilet routine despite a desire to play there. The mother expected the child to remain on the first floor because she was told to do so. False toilet warnings developed probably because of the child's desire to be on the second floor. A nursery chair was brought to the first floor to divorce need for toilet with desire to play. This together with greater freedom brought more satisfactory results. Mother's coöperation and interest was excellent throughout the observation period. Psychological test rating was "above average."

F37 The development of this child was irregular due to feeding difficulties. Many formulae were tried before the child was a year old. The physical rating was fair. Training had been irregular because of nutritional and sleeping irregularities. Observations began at sixty-five weeks and extended over a period of seventeen weeks. The mother was very coöperative, and the home conditions were favorable. F37 often showed resistance. The mother was inclined to be overly sympathetic with the child because of delicacy of health. No systematic night training was given during the period of observation. Night feedings were continued until the child was over fifteen months old. Routine and record keeping were quite regular, although a few breaks were made due to trips out of town. A nursery chair was used for training. The infant test rating was "above average."

F39 The child's early development was good as was also general health. Previous training had been given but the mother thought that the child was slow in assuming responsibility. F39 was irregular in control during both day and night. Home conditions were favorable to training. The mother had tolerated many accidents because of her child's resistance. By making routine as pleasant as possible, the mother was quite successful in gaining the child's willingness to coöperate. F39 began to warn almost from the beginning of observation. The child was eighty-four weeks old at the time of the first observation. A continuous record was secured for seven weeks. A modified toilet seat was used in training. The mother was very coöperative and kept excellent records. The infant test rating was "above average."

M40 This child was twenty-six weeks of age at the time of the first interview. No previous training had been given for either bowel or bladder control. The mother expressed interest in starting training, but after a few days of record keeping came to the conclusion that the child was too young to train. An older child of three and one-half years was enuretic. For this child, the mother reported that no night training was attempted before the child was past two years of age. The mother tolerated incontinence on the basis of her own childhood being irregular in this respect. The mother preferred not to continue observations on the younger child. Records were too incomplete to be used in this study.

M42 This child was adopted at the age of nine months. The parents had little knowledge as to habit training in infants. M42 was about sixty weeks old at the time of the first home call. Incidental training had been given on a large toilet. During the first few weeks records were incomplete and unreliable. House guests were present after the third week of the training period, which resulted in very irregular routine with the child. A month later the mother preferred to drop observations, stating that she lacked time and that the child showed considerable resistance to routine. Five interviews were made in the home. No satisfactory records were secured.

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